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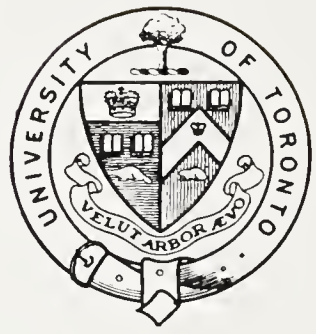


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# The Canadian Engineer

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## The Canadian Engineer.

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### INTRODUCTION.

These papers are the outcome of an endeavor on the writer's part to epitomize a vast subject into such a compass that the student or layman whose experience is pre-supposed to be "nil" may grasp it in an intelligent way. It is intended to be a foundation course only, and as such, has been largely selected from the various works bearing on each department of the subject; but the proper balancing of the parts, if such there be, giving each its due importance, the combination of the whole subject, technically considered, as a ground work for future study, and the exclusion of much confusing detail which obscures the mental vision, the writer may claim as his own.

During the present period of depression, which always so seriously affects railway construction, it might be thought that the vocation of the railway engineer was being largely obliterated; but this is not at all a consequence. Our railways must be maintained, and while more engineers, per mile, are employed during construction than afterwards on maintenance, yet, although there are, no doubt, pleasant and remunerative positions to be had during the former period, there is no condition of permanence that makes them desirable. On the other hand, railway companies recognize more, every day, the value of a technical engineering training for those young men who fill junior positions in the operating and maintenance departments, not strictly engineering in their nature.

And those companies (*e.g.*, Pennsylvania, or Norfolk and Western) that have persistently filled such positions with young engineering graduates, that have had them do routine work and given them a business training, have seen their highest offices filled by men whose engineering knowledge has brought them to the front, when aided by a good business training, a knowledge of ways and means, and of traffic and operation.

In the future, such positions, and those on the maintenance staff proper, would seem to be the paths more likely to lead to success than the more strictly technical work of location and construction, particularly as the construction in future will be chiefly in the shape of short extensions of large systems having permanent staffs.

These papers, however, will deal chiefly with location, construction and maintenance, not because these cover the whole ground, but because a knowledge of traffic, rates, operation and management can be gained only by experience, whereas a good grasp of the former may be had previous to employment of such an extent, at least, as will be valuable in obtaining and filling junior railway positions, and also form a basis for future study. And even though very little of what is here given may be used at once by the young engineer, yet it will enable him to take a more intelligent interest in all that his superior officer does, which he could not otherwise do unless he had a proper understanding of the general principles on which railways are surveyed, constructed and operated He is warned against having his faith in these principles shaken by the adverse criticism of men who do not appreciate or understand them. Care is taken to give here only what is fairly well tried and established.

On the other hand, he is advised to keep his opinions, largely, to himself, and to carry out faithfully the instructions of his superiors in office. These instructions, though perhaps sometimes faulty, should be studied and respected, so that when the time arrives that he, in turn, gives orders which must be obeyed, he may put into practice what he then considers, after several years' experience, to be best, not only theoretically, but from the standpoint of being feasible and advantageous, capable of being put into execution by his assistants—the best, all things considered.

It must not be forgotten that these papers are not exhaustive, but merely introductory. Years of reading, conversation, experience, observation, and above all, honest hard thinking, are necessary to complete a man's knowledge on any subject, and even then it is not complete. So that we must never desist, but always persevere, if we wish to keep up with the progress of this most progressive subject. C. B. S.

Montreal, Que., Canada, May, 1897.

### CHAPTER I.—FUNDAMENTAL CONSIDERATIONS.

#### ARTICLE 1.—TRANSPORTATION.

The inhabitants of the civilized world have, since the year 1825, been enabled to remodel their ideas of

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

how and where to live. There has been developed within this period a new potentiality, which had through all the previous history of the world been practically dormant. The impulse given by it to the material and industrial progress of the world is such as to stamp it as one of the grandest events of our world's history, and it will be so spoken of in future ages. It is the development of transportation.

In its broadest sense, transportation may be said to include all means of communication; but of its various phases the transportation of material objects by means of the railway train will be the one treated of in this book.

The railway had its birth in England, and a fierce struggle took place between it and the canal for supremacy, while in North America the canal systems not being far advanced, and the extent of territory to be traversed rugged and vast, the result was never in doubt; to-day, the canal is a useful regulator of rates, and a means of transportation of heavy bulk freights in which time is not a factor, but it cannot be said to be a competitor of the railway to any serious extent.

By 1850 the people of North America had grasped the fact that the rapid extension of our railways to the remote and unsettled regions westward, was the key to that marvellous growth that has peopled a continent in so short a time. The capital available was small, and the country fairly rough, so that different methods of construction and operation from those in vogue in England, and a consequent different class of equipment, were imperative.

At the present day, in Canada, our railways are developed along the same general lines as those of the United States, and in it we have done our fair share, but it must be recognized that to the civil engineers of the United States is due the credit of those essential departures from early forms which have defined our continental types so distinctly, and are the glory and the boast of North Americans. These departures took place gradually, the gap becoming wider every year, until now it has passed its maximum, and the slow conservatism of English engineers is yielding. Bogie trucks, equalizing levers, Westinghouse brakes, and American cars are becoming familiar in England, while on the other hand increased wealth and traffic are enabling American railways to introduce block-signalling and interlocking systems, to abolish many grade crossings, and make their road-beds more solid and permanent.

The distinctive features of the railway system of North America that have enabled it to extend to a length of over 200,000 miles (including Mexico and Central America), that have given Canada a system of over 16,000 miles, moving 22,000,000 tons of freight, 14,000,000 passengers, 60,000,000 newspapers, 100,000,000 letters, besides much express, etc., each year, having a capitalization of $900,000,000, and employing an army of perhaps 55,000 men, are as follows:

(1) A frank recognition of the fact that curvature is not a great drawback, and can be introduced freely to economize construction.

(2) The introduction of bogie and swivelling trucks and equalizing levers, enabling lines of poor surface and sharp curvature to be operated safely and economically.

(3) The use of long wheel-bases on engines for freight work, enabling greater weight to be put on the drivers of engines operating over quite inferior track.

(4) The consequent hauling of increasingly heavier loads of freight per engine and per train crew.

(5) The lowering of freight rates to a point that enabled coarse freights to be worth moving, thereby increasing the volume of freight enormously.

(6) The acceptance of a timber-construction period, enabling roads with meagre early traffic to pay their small fixed charges and survive until their finances and credit are such as to enable them from their earnings or by increased bonding to replace such structures with permanent ones. The Canadian Pacific Railway is a striking example of this.

(7) The use of increasingly heavier freight cars, in which paying freight is a larger percentage of the gross load—and also giving a less co-efficient of rolling friction—which the following table illustrates:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1875 | ..20,000 lbs. | car, | 20,000 | lbs. | freight, | 50 per cent. | dead load |
| 1880.... | 24,000 | " | 40,000 | " | 37 | " | " |
| 1890.... | 28,000 | " | 60,000 | " | 31 | " | " |
| 1896... | 36,000 | " | 80,000 | " | 31 | " | " |

From which it appears that the limit has been reached.

## ARTICLE 2—PROJECTS.

A company of limited liability, but whose capital is inelastic and non-circulating, must do business or break down; it cannot contract its business in hard times except at a sacrifice; business at starvation wages is better than none, and this is the exact condition of a railway company which is a manufacturer and seller of transportation. In this it is different from a store, or more particularly a banking house, therefore all the more carefully should the project be studied before money is embarked in it.

No considerations of a general character will cover all cases, and therefore it will be necessary to exclude roads which have been or may be built (*a*) for purposes of blackmail, to force rival companies to buy them out; (*b*) for speculation of the builders, not owners. These are not legitimate enterprises, but ones which projectors start by the expenditure of a small sum for charter, issue of bonds, etc., expecting to charge a margin for selling the bonds, to form construction companies, and let the contracts of construction to themselves at high prices, getting all the money out of the bondholders, running no risk themselves, but controlling all management by means of valueless stock. This gives them all the voting power, and any extra profit remaining after the bond coupons have been paid. Even such roads as these, however, will profit in the same way, as legitimate enterprises, by the application of true economy in location and construction.

Cost is the basis of all business, and most particularly in the case of railways must this always be so. An engineer may insist on technical accuracy and massive work, to such an extent as to bankrupt his company before the road is on a paying basis or even built, or he may, in an ill-directed effort toward economy, give it such a miserable constitution of grades and position, relatively, to its customers, that it will never secure traffic, and could not handle it economically if it did. Between these two extremes, the intelligent engineer should strike a happy balance, so that the project may be where it can obtain most traffic, at least first cost consistent with moderate working expenses, so that it will be profitable to the present owners or promoters, who usually build the road on borrowed money up to a certain safe mortgagable amount.

The promoters of roads are always sanguine, and probably the most common error into which such men

usually fall, is to overrate the funds on hand or in view, and on the other hand, to underrate the cost of the completed enterprise. Roads are seldom built within their first estimated cost, and therefore, this is a danger against which the chief engineer must guard ; he must be sure and firm in his figures, because it is difficult to foresee all contingencies, and still more so to impress the directors with the reality or necessity of each item.

The finances at the command of the company should always be fully known to the chief engineer ; he has the right to know it, and should have the courage to insist on the fullest confidence of the directors. These means should be carefully studied, allowances made for changes in the money market affecting the value of bonds, the amount of money which can be raised easily, and the difficulty in getting the *last* part of the required amount should also be considered. Usually the bonds of new roads, just being built, sell below par, and, as the amount issued increases, the selling price may get less and less, until they may become unsaleable.

Many roads become bankrupt before or just after construction is finished, and a promising project ends in a receivership, the wiping out of past debts, or issue of prior-lien bonds on the part of the bondholders themselves. Receiverships, instituted originally to protect bondholders, are often made the instruments of defrauding them. The history of the railways of the United States, particularly, is full of examples of unnecessary roads built on faith and hope, and ending in disaster or fraud. Over 25 per cent. of United States railways are now in receivers' hands, and nearly all have passed through that stage in some period of their history.

The most casual observation teaches that in a country like Canada, where traffic is still unfortunately very light, we must build roads with the utmost economy. This has been practised in several justifiable directions.

(*a*) The introduction of curves where necessary, with a sharpness of as high as 4° to 6° on main lines, and 8° to 10° on branches, with a frequency only limited by a piece of tangent of 200 to 400 feet long between curves ; in this way, by a slight addition to the cost of hauling trains and length of line, the cost of road-beds has been kept at a minimum.

(*b*) The use of fluctuating grades, by which the local "sags" or depressions do not increase the cost of hauling trains, but cheapen the cost of construction materially, and which have no objectionable feature except a change in train speeds, as they store up or yield a part of their "velocity head."

(*c*) Timber structures over all important streams, and even timber box culverts under light banks ; in this way a railway company is enabled to get its road in operation quickly at a minimum cost, is able often to tide over the first few years of meagre traffic, replacing them, gradually, as means will permit, with permanent structures. On the other hand, there are certain directions in which economy cannot be practiced.

(*a*) Narrow gauge roads, except in isolated cases, have now been abandoned, because the demands for interchange of traffic put them at a disadvantage ; because the cost of construction is higher in proportion to carrying capacity of cars, etc., and chiefly because it is found that American engines of standard gauge can pass around any ordinary curve quite freely.

(*b*) Light rails. This will be dealt with more fully in future chapters, but it may be well to say here that with rails quoted at $20 to $25 per ton, there is no greater blunder than to buy light rails. In stiffness, strength and wear the increase varies nearly as the square of the weight per yard, thereby decreasing maintenance charges enormously as the weight increases. The present weights are roughly 60 lbs. per yard for branches and 80 lbs. for our main lines, with a strong tendency upwards.

(*c*) Excessive ruling gradients. Almost any other mistake can be corrected in time, curves can be flattened, short grades lifted, temporary structures replaced, but the ruling grade is the life or death of a road that has or expects to have any traffic beyond a meagre minimum. This question will be fully dealt with in Chapter II.

(*d*) Locating roads adjacent to but not through towns. Many instances might be given of this fact, where railway companies, in order to save money on right of way, to shorten the line slightly, or out of pique at not receiving bonuses, have built the road a mile or more away from the centre of population. Experience proves, however, that it is usually profitable to pass as near as possible through the *very heart* of all towns or cities, even at considerable extra expense.

The engineer must, therefore, when entrusted with a study of proposed routes, have several leading ideas constantly in his mind :

(1) How to obtain the most traffic, including the idea of shutting out, avoiding or fighting competitors.

(2) How to get a road built with as small fixed charges as possible consistent with small operating expenses, and clause (1).

(3) How to build a road that will be operated and maintained at as small a charge as is consistent with clauses (1) and (2). *These three things are intimately intertwined*, but may be affected by such considerations as obtaining heavy local aid, having heavier grades in direction of lesser traffic, and a complete change of train loads at the end of each engine division (100 to 130 miles), excepting always that the whole road will allow the passage of moderately heavy passenger trains intact.

Unfortunately these matters are often, erroneously enough, may be, settled quite apart from engineering ideas, politics and local aid being the controlling factors ; but facts remain, and while politicians perish and local aid, once given, looks for a *quid pro quo*, the railway burdened with too heavy grades, too much debt, or distant from its customers, will gradually, but surely, fail in the race. The problem which has to be solved, in each case, is to create a paying property without satisfying, often, the dangerous desire on the part of the engineer to build solidly and erect monuments to himself, or satisfy his innate desire for excellence of construction considered from too narrow a standpoint. This is a difficult matter in a thinly settled country like Canada, as statistics to be given will show, but our roads are being more economically constructed and operated day by day and traffic is slowly increasing, so that we may confidently look forward to a time when there will be a change and some small returns for the stockholders and promoters.

(*To be continued.*)

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## BRITISH RAILWAY ENTERPRISE.

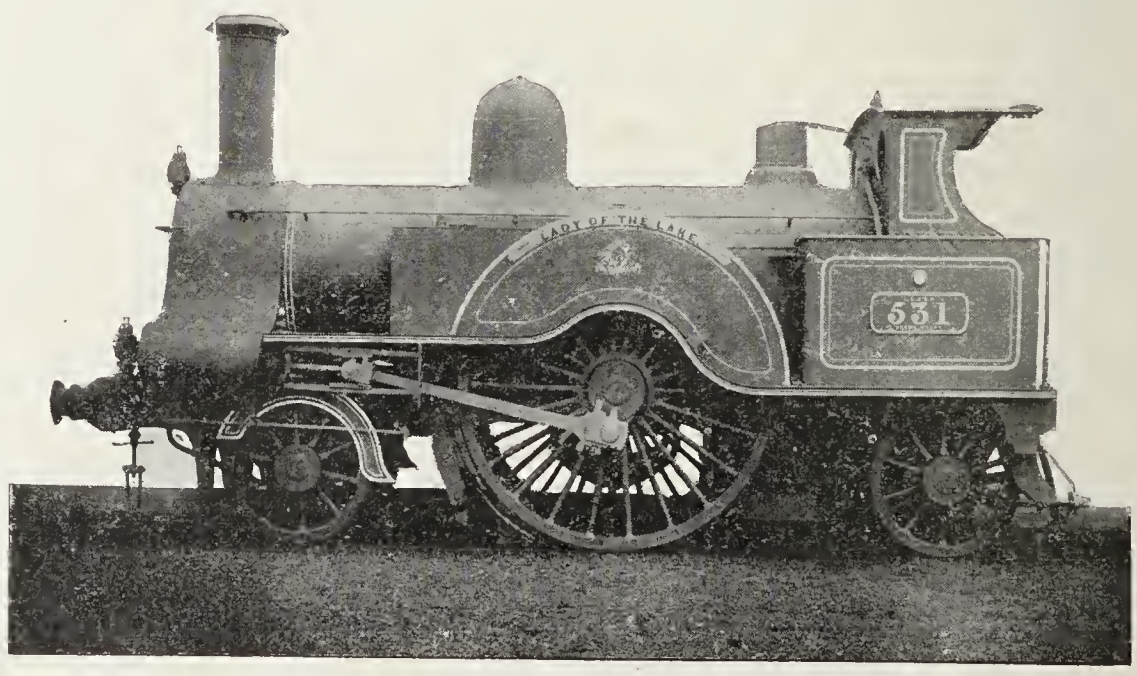
*(Correspondence of* THE CANADIAN ENGINEER.)

Before the writer set foot in England he was inflated with the idea common to Americans (using this word in a continental sense) that we were ahead of the world in railway enterprise and railway management. A few journeys over Great Britain and a short study of the two systems will dispel that idea as an illusion.

ENTRANCE TO EUSTON STATION, LONDON AND N.-W RAILWAY.

It is true that the American tourist will, generally speaking, miss his convenient system of baggage checking, and will see the faults of the compartment system of passenger cars ; but if he travels by the London and North-Western Railway, he may have the American system applied to his baggage, with the American feature of "baggage smashing" omitted, and if he is travelling on a through train he will find dining cars, sleeping cars and parlor cars on a modified American plan, quite as luxurious, quite as convenient and affording easier riding than any in the United States. But assuming that this splendid Americanized special service on the London and North-Western did not exist, the unprejudiced American will find on investigation that the system in use in the United States and Canada could not be wholly applied to Great Britain without depriving it of some of those distinctive points which make it on the whole the most efficient and best managed railway system in the world—for in the three great essentials, solidity of construction, average speed of trains, and safety of passengers, the railways of Great Britain stand unequalled. On a previous visit to England the writer remembers reading the annual report of the London and North-Western. Out of over 25,000,000 passengers carried that year by this company, not a single passenger's life was lost ! Think of the efficiency, the care, the regularity and intelligence this means. No such record has been known in any corporation of like dimensions in the history of American railways. Then as to speed, it is true that the "Empire State" express on the New York Central now holds the record for the fastest train in the world, but that is an exceptional performance, and the average speed of the New York Central expresses is below that of the leading English railways. Taking a late time table of the London and North-Western, I find that the six expresses running daily from London to Carlisle make an average of 45.4 miles per hour, and on the return to London the eight expresses make an average of 44.5 miles per hour, while the New York Central's four expresses from New York to Buffalo make an average of 43.6 miles per hour, and returning from Buffalo to New York the average is 42.9. The difference is nearly two miles per hour in favor of the London and North-Western, though the grades on the English road between Crewe and Carlisle are much more severe than those on the New York Central.

Although the area of Great Britain is so small compared with the United States and Canada, and although it has been for years covered with a net work of rails, while vast regions of America are still unserved, the mileage of new roads was relatively greater during the last year under review (1895) in Great Britain than the United States, and what is still more remarkable, the British roads return better dividends. In 1895 there was added to the United States railways 1,628 miles, while in Great Britain the mileage added was 270. In the same year the railways of the United States earned a dividend of 2.94 per cent., while those of Great Britain earned 3.95 per cent. In both cases the dividends are less than in former years ; partly due, no doubt, to the increasing use of the bicycle, and in the case of the United States to the growing competition of the electric railways in some States. In addition to this the widespread depression in the United States has no doubt put a check on new enterprises, and new roads are not built for the benefit of contractors so much as they used to be. Anyone travelling over Great Britain is struck with the solidity of the permanent way, the substantial character of the stations,




"LADY OF THE LAKE" PASSENGER ENGINE, WITH 7 FT. 6 IN. DRIVE WHEELS—L. & N.-W. RY.

the numbers of solid bridges, viaducts, culverts, archways and tunnels—all built to last for ages. The English railway builder goes through a mountain, the American goes over it. The cost of construction of British railways is about double those of America, but the receipts of British railways in 1895 were over three times those of the United States, being $19,220,

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mechanical engineer—so that the engine, though of great length, can travel safely over curves. The engines on the L. & N.-W. consume over 3,000 tons of coal per day. In my next letter I shall speak further of this company's great shops at Crewe

*For* THE CANADIAN ENGINEER.

## FORMATION AND AGGLOMERATION OF FRAZIL AND ANCHOR ICE.

BY HOWARD T. BARNES, M.A. SC., DEMONSTRATOR IN PHYSICS, M'GILL UNIVERSITY, MONTREAL.

In northern countries there is no subject which presents so many practical difficulties to the hydraulic engineer as the formation of frazil and anchor ice, and their subsequent agglomeration into masses. The relations of these phenomena to the temperature of the river water have been repeatedly under investigation, but while much valuable work has been done already, the observations have been of such a contradictory nature, especially as regards the temperature of the water, that very few practical suggestions have resulted. The purpose of the present paper is to endeavor to present to the readers of THE CANADIAN ENGINEER a simple and intelligible explanation of the appearance of frazil, based on a long series of experiments undertaken on the St. Lawrence River, to show the dependence of its formation on the temperature of the water.

Among those, in later years, who have taken the keenest interest in investigating the question of frazil is John Kennedy, who is the chief engineer of the Harbor Commissioners' Works, at Montreal, and it was through him that the writer's attention was first directed to the importance of the work. Mr. Kennedy had long felt that some connection existed between the agglomeration of frazil ice and the temperature of the river water, but could not with the apparatus at his command satisfactorily demonstrate that such a relationship existed. Under his direction, as a member of the Montreal Flood Commission, temperatures of the river water during the winter were taken by W. J. Sproule, the assistant engineer, both under the surface ice and at Lachine in open water. Although great care was taken with the measurements, no definite variation from 32° F. could be detected even in the most severe weather. The measurements were taken with an instrument designed by Mr. Sproule, and consisted of a mercurial thermometer reading to tenths of a degree, enclosed in a tin case so that a quantity of the water to be measured was brought up and served as a protection against the colder air. By this means it was clearly shown that if any deviations from the freezing point took place, they must be less than can be measured on a thermometer reading only to tenths of a degree.

Mr. Kennedy, with the object of testing the matter more accurately by means of more delicate thermometers, consulted Prof. Callendar, of McGill University, in regard to carrying on the work by means of an electrical resistance thermometer. Prof. Callendar accordingly designed, and had constructed in the McDonald Physics Building, a thermometer capable of reading differences in temperature to the thousandth part of a degree centigrade. As the employment of this thermometer entailed considerable practice in the use of electrical measuring instruments, and Prof. Callendar was wholly occupied with the work of the session and had no spare time to devote to the observations, the writer undertook the measurements at Prof. Callendar's request.

An electrical resistance thermometer is really the only form of instrument suitable for measurements of this kind, not only because it measures with a far greater degree of refinement than can be looked for in a mercurial thermometer, but because it may be read from a sheltered place without withdrawing the stem from the water. Very little reliance can be placed on observations made on any temperature measuring instrument which has to be taken out of the water and read in an atmosphere cooled down far below freezing.

The thermometer used was of the differential type and consisted of two stems, each made of a similar coil of platinum wire. The coils were balanced against each other by the well-known Wheatstone's bridge method. The coils of wire were protected by small lead composition tubing, about eight inches long, which was soldered to longer and thicker compo-tubing containing the connecting leads. One end was made 100 feet long, to pass into the river, while the other end was made 10 feet long, for retention at a uniform temperature in a sheltered place.*

The temperature of the water was determined, not directly, but more accurately, as a small difference from a carefully prepared mixture of snow and water. Every possible error, due to changing temperature conditions, in the connecting leads and on the rest of the apparatus, was compensated for. The thermometer was so made as to have a scale of 8 inches to the degree and a vernier with lens reading to $\frac{1}{2500}$ of an inch. Under suitable laboratory conditions it was possible to measure to $\frac{1}{10000}$ part of a degree centigrade. In the present case, in spite of obvious difficulties in making refined electrical measurements in a light shanty unprotected from the wind, readings were accurate to $\frac{1}{1000}$ of a degree.

The method of making an observation consisted in immersing the two ends of the thermometer in a mixture of snow and water in the shanty, and obtaining a zero reading when both the ends were at 0° C. The shorter end was left in the mixture and the longer end passed out of the shanty into the river. Any difference in the temperature of the river from the mixture of snow and water in the shanty was immediately obtained. During the winter of 1895-96 the writer carried on the experiments for a considerable time on the river water, under the surface ice, opposite Montreal, and, during the winter of 1896-97, made a similar series of observations in open water at the Lachine Rapids. A shanty was provided at both places by the Harbor Commissioners, through the kindness of Mr. Kennedy, and served for the reception of the instruments and for making the measurements. A watchman was also procured to protect the instruments.

The results of the first series of experiments have been recently published in the "Transactions of the Royal Society of Canada," vol. ii., sec. iii., page 37, and those of the second series will, it is hoped, be published in the course of the year. In the first paper will be found, besides the results of the observations, a description of the instruments used in the investigation, and a brief discussion of some of the principal points brought out by previous observers.

The general results of the writer's experiments have

* The writer desires here to express his thanks to H. T. Pye, instrument maker in the McDonald Physics Building, for willing aid in renewing, at short notice, delicate portions of the apparatus which were broken through want of proper laboratory conditions.

been to show that the temperature of the river water under the surface ice does not vary throughout its depth by more than a few thousandths of a degree from the freezing point during the entire winter. During the time in which the measurements were made the air temperature varied from −28° F. to + 40° F. Small differences from the freezing point are recorded, and these are found to accompany atmospheric changes. A sudden drop in temperature of the air below 0° F., after a warm spell of weather, would invariably send the temperature of the water slightly below freezing. On February 25th, 1896, an observation after a sudden cold dip gave a difference from the freezing point of −.005° C. On March 4th a similar cold dip gave −.006 to −.0004°, and on March 11th, −.004° C. It was found that these small differences below freezing never continued, although the air temperature remained cold. The river soon came to the freezing point with the apparent accumulation of frazil under the surface ice. During mild weather the temperature of the river never rose more than one or two thousandths of a degree above freezing. From the experiments in open water it was found that the variations were of the same order below freezing as those under the surface ice, but the extent to which the river could become warmed through the influence of sun and rain was much larger than could be expected under the ice.

Differences of opinion have existed to a great extent among observers in regard to the temperature of the river water in winter. Mr. Kennedy has charts of air and river temperatures for three years, taken for the Grand Trunk Railway by the late T. D. King, at Victoria Bridge, under the surface ice. There are recorded variations of temperature of the water amounting to several degrees below freezing to several degrees above. It is not known to the writer how the measurements were taken, but as these variations are very large and are not found to correspond with the atmospheric changes, they suggest possible errors of observation. Since then a number of observers have expressed the confident opinion that the river water in winter is cooled considerably below freezing. In one case an observer had noticed on very cold days the water in the river above the Lachine Rapids at the mouth of the waterworks to be in general 32° F., and sometimes 31° F., down to a depth of 20 feet. Here again no details have been given as to how the measurements were taken, or what methods were adopted for reading the thermometer in a cold atmosphere. It is important for observers, who have actually found large differences from the freezing point, to state clearly how the readings were obtained, since from Mr. Sproule's measurements and those of the writer's no considerable variations could be detected.

With special laboratory precautions it is undoubtedly possible to cool water, free from ice and dissolved air, to several degrees below freezing, without the formation of ice. On the slightest agitation, however, or on the introduction of the smallest crystals of ice, there will be formed all through its mass long needle crystals of ice in sufficient quantity to bring the mass of water to the freezing point. It will then be found impossible to further cool the mixture of ice and water so long as any water remains.

Ice and water can exist together only at the freezing point. If heat is abstracted from the mixture there is apparently an isothermal change of water into ice, and if heat is supplied to the mixture there is apparently an isothermal change of ice into water. From theoretical reasoning a large temperature difference between ice and water in the same solution could not possibly exist. It seems impossible then to imagine a flowing river, either with surface ice or mixed with frazil, to be cooled appreciably below the freezing point. The small differences observed by the writer would, however, appear to indicate that the process, although apparently isothermal, is in reality dependent on small temperature changes. This has already been claimed by some authorities, and the results of investigation have been to indicate that the temperature of a mixture of ice and water to a certain minute extent depends on the relative amounts of ice and water present and whether the mixture is rapidly freezing or thawing. The fact that under surface ice, on a sudden drop in air temperature, the water commenced by being in a slightly undercooled state, and then as the ice grew and the proportion of water became less, the temperature came nearer and nearer to the freezing point, would tend to support this view. Of course these variations are exceedingly small, and could only be detected with very delicate apparatus. They would not be noticed on a thermometer reading only $\frac{1}{100}$ of a degree.

The idea will immediately suggest itself to the reader, whether or not these small differences observed by the writer could have originated in the artificially prepared mixture of snow and water containing the steady end of the thermometer. It would be out of place here to go into details over the many precautions necessary to avoid errors of this kind, but it may be said that it is possible, within the limits of these measurements, to prepare mixtures which will be sufficiently uniform.

Larger temperature differences may very probably exist in quiet water where there is little or no ice, but the more water is being churned up and mixed with air and ice, the less can its temperature be cooled below the freezing point. It was, therefore, almost certain, *a priori*, that the temperature of the river water in the rapids could not differ materially from the freezing point. Nevertheless it is satisfactory to have been able to demonstrate the fact by direct observation, and at the same time to detect such small variations as should theoretically be due to the rate of formation or dissolution of the frazil.

Previous observers have differed a good deal in regard to the way in which they have explained the appearance of river ice. The terms "Frazil" and "Anchor Ice" have been used synonymously, and are apparently often understood as the French and English for the same thing. From the report of the Montreal Flood Commission, published in 1890, which is undoubtedly the highest authority on river ice formation which we have, it is seen that "Frazil, as distinguished from anchor ice, is formed over the whole unfrozen surface above and below Lachine Rapids, between Prescott and tide water, and wherever there is sufficient current or wind agitation to prevent the formation of bordage ice. . . ." The term anchor ice includes of course only such ice as is found attached to the bottom, but frazil is apparently frequently used to include ice formed on the bottom as well as throughout the mass and surface of a river. In the present paper the distinction indicated by the Flood Commission has been adopted, and frazil is not used so as to include ground ice.

To the writer, the formation of ice in a river cooled to the freezing point, appears to be due to two causes:

(*a*) Loss of heat by contact with a cold air; (*b*) Loss of heat by radiation. The first cause is probably responsible for the greater amount of the fine floating ice seen in our rivers whenever the current is too rapid to permit of the formation of a surface sheet. The churning up of the water in shallow rapids is simply a special case of this, in that a greater area of surface is exposed to the influence of the colder air, causing a more rapid abstraction of heat. In quiet waters subjected to a cold atmosphere, every one has noticed how long needle crystals of ice shoot out horizontally in all directions over the surface. These crystals by increasing and compacting form the first layer of surface ice. In agitated water, time is not given for surface crystals to grow to any size. On the contrary, small needle crystals are formed, the degree of fineness depending on the rate of agitation.

An experiment was carried out at McGill University, by Prof. Nicolson, which will illustrate this point. A quantity of water in a tub was kept in rapid motion under the influence of a cold atmosphere in winter. The result was that fine needle crystals of ice, in every respect similar to frazil, were formed throughout its mass, until the whole became somewhat like a thin paste. During the progress of the experiment no deviation in the temperature of the water from freezing could be detected with a thermometer reading to hundredths of a degree. In smooth, gently flowing water it is possible to have thin, flat plates of ice formed which become mixed with the finer crystals. Previous observers have noticed these plates mixed up with frazil and have endeavored to draw a distinction between the two. It does not seem necessary to draw a distinction, as these will be formed in a river ice of every degree of fineness.

Loss of heat from the water under the surface ice will take place by slow conduction through the ice, the upper layers of which must be nearly at the temperature of the air. In the experiments conducted by the writer under the surface ice, it was noticed that when the air temperature was very cold, long needle crystals would grow out which could be seen through the hole cut for the thermometer. This fact has already been noted by previous observers, and shows the tendency for surface ice to grow on the underside. The writer has seen the opinion stated that surface ice never grows in thickness beneath, but always on top. The explanation given for this is that ice is always somewhat porous and water is drawn up through pores and frozen on the surface. It is difficult to conceive how this could take place through two or three feet, how water could be drawn through a mass of ice cooled below freezing, as surface ice must be, without its becoming transformed into ice on the way. In this case the pores, if they ever existed, would soon become choked up. It has been urged as a further proof that the surface level of ice formed on a river rises, even though the water does not. This would naturally occur as the ice would be continually buoyed up as it grew deeper into the water. This force would of course act so slowly that the surface ice would move without cracking, continually adjusting itself in response to the pressure underneath.

In regard to the second cause of the loss of heat in a river, there has been a good deal of dispute. Some claim that as all the phenomena of ice formation in a river may be satisfactorily explained without the aid of radiation, it is unnecessary to introduce it at all. But as radiation exists, as is shown by Dr. Wells' beautiful experiments on the formation of dew, described by Prof. Tyndall, it becomes important to see how far it influences the formation of ice in a river. On clear days, irrespective of the temperature of the atmosphere, immense quantities of heat are radiated from the earth off through the atmosphere into space. This has the effect, as is well known, of cooling the surface of the earth, which in its turn cools the atmosphere. During cloudy weather the heat radiated from the earth is reflected back again by the clouds, so that under these conditions the earth does not become cooled. From Tyndall's experiments on radiant heat, it is seen that heat rays may be passed to a certain extent through clear water or clear ice. He beautifully illustrates this by heating platinum red hot in the sun's rays, concentrated by a lens of ice. There is no reason then why the bottom of a river should not radiate heat straight through the water and atmosphere into space. Then the bottom will become cooled below the temperature of the water, which in winter is at the freezing point, and ice will be formed *in situ* by the abstraction of the latent heat of the water in immediate contact. The process of thickening will take place by radiation from the surface of the ice itself. Radiation from the bottom will be, of course, greatly hindered by the granular texture of the ground ice, and when it becomes so thick as to prevent any further radiation, or on a cloudy day, not sufficiently cold to produce undercooling in the water, heat slowly conducted through from beneath will melt off the hold which the anchor ice has on the stones and rocks.

Engineers have held that heat conducted through from beneath must help to keep up the temperature of the river, and that stones could not become cooled below the freezing point on account of this. One observer says: "How then could a stone, whose upper surface is at, or almost at, 32° F., and whose lower surface is at a somewhat higher temperature, radiate cold into a body of water from which it is itself receiving cold?" From the results of the observations on soil temperatures which have been carried on now for several seasons at the McDonald Physics Building by Prof. Callendar, in conjunction with Prof. McLeod, with delicate electrical thermometers placed at different depths in the ground, it has been shown that the conduction of heat through the earth from beneath is exceedingly slow. It may be easily calculated from the results of their work that the amount of heat which would be conducted through the earth to the bottom of a river in one hour, would not be sufficient to melt a layer of ice more than 1-500 of an inch in thickness.

It is very improbable that ground ice could be denser than normal, and therefore prevented from rising, as some observers have thought. There are certainly no experimental data to support such a supposition. On the contrary, the growth of the crystals in a mass of anchor ice is as far as possible in a vertical direction, showing that the ice must possess buoyancy even as it forms. This no doubt gives rise to the beautiful tree-like forms of masses of ice on the bottom, resembling the weeds in summer. Where a river is flowing very gently and smoothly a surface layer of ice forms, which becomes covered very soon with a layer of snow. This layer of snow will act as a check to radiation, hence the well-known fact that anchor ice does not form under a layer of surface ice. There is another possible reason why in deep, gently flowing rivers, ground ice is not readily formed. Below 39° F. it is well known that warmer layers of water sink to the

bottom and colder layers rise, so that the bottom of a deep river may be above 32° F. As a matter of fact the writer found the water under the surface ice slightly warmer at a depth ; otherwise there seems to be very little reason why ground ice should not be formed under a layer of clear surface ice.

There is very little doubt that the immense thickness of several feet which anchor ice attains must be due, partly, to the sticking of surface formed ice carried down by currents which are continually shifting in a rapidly flowing river. The branching form, in which anchor ice grows, would tend to entangle and collect the floating ice. This sticking together of the ice was only noticed by the writer when the water was in a very slight undercooled state, caused by excessive abstraction of heat. The two principal atmospheric conditions for producing this effect the writer considers to be a dull, cold stormy day with wind, or a clear cold night. When measurements were being made of the temperature of the water in this state, in a shallow part of the rapids near the shanty, the stem of the thermometer was placed on the surface of some ground ice, which could be distinctly seen through the water. In a very short time the stem was frozen down, and could only be removed with great difficulty without injuring it. It is interesting to state that the writer was actually observing a small difference below freezing during the time the lower portion of the stem was becoming attached to the bottom. During this time immense islands of ice appeared in the shallower parts of the rapids, apparently growing by the attachment of frazil carried down by the currents. The river was of a dull, sandy color, as though full of ice. The whole tone of the river seemed different to that on a similar dull mild day.

Mr. Keefer, former president of the Canadian Society of Civil Engineers, in the discussion following G. H. Henshaw's paper on "Frazil," published in the transactions of that society, for March, 1887, gives an observation made by himself, which accords well with the one made by the writer. He has noticed that while crossing the St. Lawrence, opposite Montreal, in a canoe, when the thermometer was below zero, and when there was no floating ice, the water, instead of being clear as usual, was lead-colored, thick and "sandy" with ice. He further goes on to say that "spicules of ice, about the size of darning needles, attached themselves to the paddle by their points, and when it was withdrawn from the water stood out at right angles to the wood." He goes on to express the opinion that in this condition the river was loaded with ice spicules to the bottom, densely and uniformly distributed throughout the whole mass, and would supply the raw material for the formation of anchor ice at the bottom, when the latter was prepared to receive it. In this condition the writer thinks that had any ice been already formed on the bottom by radiation, then the lower layers of these ice spicules would have become entangled and subsequently attached.

Regelation has been proposed as an explanation of the way in which ice sticks to the bottom. This is very improbable, for there is quite a difference between the coalescence of ice particles by continued pressure, which cannot take place between ice and any other body, and the freezing together of ice crystals due to a natural growth on their surface. Even during very cold weather the sun has an enormous influence in determining the temperature of the river water. Its rays undoubtedly penetrate to the bottom and melt off the anchor ice. The writer has frequently noticed in the morning that, after a cold, clear night, beyond the amount of frazil floating down in the currents, there was no other ice visible, while as soon as the sun became brighter and more powerful, large masses of anchor ice were brought up from the bottom and floated down. Mr. Keefer states that mill-owners never find any trouble from the formation of anchor ice, no matter how cold the air is, if the sun is shining, and also if there is a cloudy sky at night. This again points to the formation of anchor ice by radiation.

In order to test the effect of radiation in the water, the writer arranged some experiments by which it was made apparent on the stem of the thermometer. During the day, when the sun was shining, it had always been noticed that the water was a little warmer than freezing, even though the air temperature was considerably below freezing. The writer found that by placing the thermometer at different depths in some comparatively quiet back water near the shanty, the upper layers of the water were always warmer than lower layers, and if the thermometer stem were sheltered from the direct rays of the sun, it showed a still lower temperature. The water within eight inches of the surface was apparently considerably warmer than freezing, although the air was very cold. No other explanation of this could be given, except that the sun's rays were radiated through the water and were warming up the stem of the thermometer itself.

Experiments were also tried to test the effect of having the thermometer actually cooled by radiation. These observations had to be taken during a very cold clear night. The result accorded closely with the expectation. The details of these observations would perhaps be somewhat beyond the scope of the present paper, but the writer hopes elsewhere to be able to give the actually observed differences of temperature in support of these assertions.

It will be of interest here to give two examples which have come under the writer's notice, the first one by direct observation and the second one through Mr. Kennedy, which will serve to illustrate the tremendous power exhibited by frazil during the time when it is agglomerating. Engineers have found this to be the most destructive state for the frazil to be in. It has been already shown that this is probably due to the temperature of the river being very slightly below freezing. During the course of the winter quantities of frazil are being manufactured in the Lachine Rapids and swept under the barrier ice by the swift currents. This frazil on reaching quieter waters soon rises and becomes attached to the underside of the surface ice. If reference is made to the report of the Montreal Flood Commission, it will be seen on the charts made of the cross sections of the river at different distances below the rapids how, the nearer the section is to the rapids, the greater the area of ice and the less the free waterways, while the further away, the less the total area of ice and the greater the channels. During a severe cold spell it would not be difficult to imagine the free waterways becoming completely choked up. This apparently occurred during the past winter, for during a severe storm about the end of January, the level of the water rose, and by increasing the head produced a shove.

It is well known how the Ottawa and St. Lawrence Rivers meet at the head of Ile Perrot and flow around the island into Lake St. Louis, the Ottawa on the north side and the St. Lawrence on the south side.

For a long way the waters do not mingle, but flow side by side. The Ottawa River has also another course around the Island of Montreal. During a continued cold spell so much frazil is made in the open water of the St. Lawrence, just before it enters the lake under the surface ice, that the channels become almost completely blocked. The water is consequently forced around the head of the island into the Ottawa River channel. This in turn forces the Ottawa entirely into the back river course. The Montreal waterworks obtain water on the north side of the river above Lachine rapids, and under normal conditions receive almost entirely Ottawa River water. When the Ottawa is forced out of its channel and its place taken by the St. Lawrence, the fact is made apparent by the difference in color of the tap-water in the city.

In conclusion, a great deal might be said about frazil, with reference to the construction of hydraulic works, but as the present paper is simply an explanation of the appearance of river ice in its many forms, from the point of view of a physicist, the rest will be left to those more competent to deal with that side of the question.

As in northern countries it will be impossible to prevent the formation of frazil ice, it becomes the duty of the engineer to make a careful study of the facts attendant on its manufacture and agglomeration, and to apply such knowledge intelligently. As we continue to grasp more and more the true scientific nature of river-ice formation, we may hope, not without reason, to find possible methods for tempering its effects. The practical advantages to the industries of the country derived from such a result would be incalculable.

*For* THE CANADIAN ENGINEER.

## ANYONE CAN ASSAY.*

BY ALEX. ROY, TORONTO.

[The following easy method of making a test for gold is the cheapest and most convenient of which we know. The instructions must be followed with precision, and to attain good results, a certain dexterity in handling the materials is necessary; but this may be attained by practice.—ED.]

MATERIALS.

The actual requirements for finding out if an ore carries gold, are :—

A good hammer.
A few crucibles.
A few cupels.
5 cents worth of litharge.
5 " " washing soda.
5 " " cream of tartar.
5 " " nitric acid.
A small quantity of salt.

This amount will make half-a-dozen assays, and the materials can all be carried in a small grip. Cupels are made of bone ash powdered up as fine as flour. This can be bought for about twenty cents a pound, and one pound will make about forty, and can be carried in a small pepper-box, packed inside with paper to prevent their being broken. Litharge can be got at any village drug store. Cream of tartar or washing soda can both be found in any farmhouse, as also salt.

The usual method of prospecting is to arrange board for a week at a farm house, except in uninhabited districts where camping is necessary, and prospect around a day's walk in different directions, then go on to the next place. Gold can be looked for to advantage in the neighborhood of any reported discoveries. The writer has made assays of gold ore from almost every county in Ontario north and east of Lake Simcoe and Peterborough, all of which showed more or less gold.

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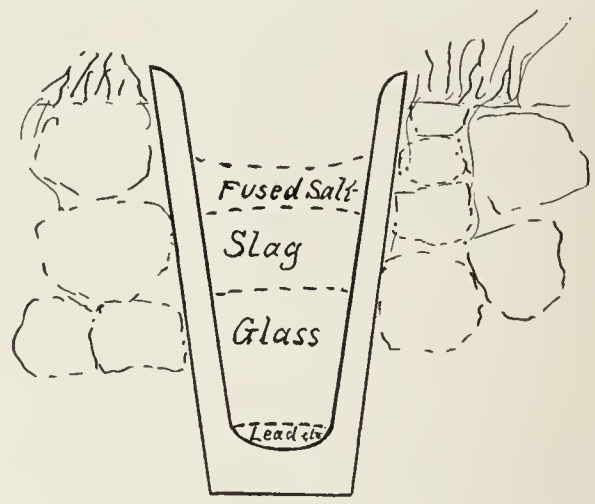
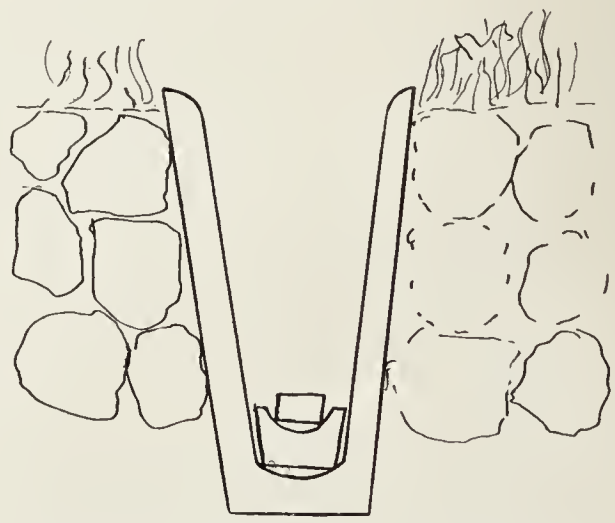
PROCESS.

Pound up the ore to powder and mix it up well, then shake it so as to make any heavy gold fall to the bottom, then take one tablespoonful (= one ounce), or for accurate work 1 ounce, and lay it on a piece of paper, then take a tablespoonful of washing soda (= one ounce) and mix it with the ore, then a teaspoonful of cream of tartar ($\frac{1}{4}$ or $\frac{1}{2}$ ounce) and mix it in with the other two, and add a tablespoonful of litharge (two ounces) and mix it with the rest. Then pour the whole




of it into the crucible, cover it with salt $\frac{1}{2}$ inch in depth, and place the crucible in a good fire so that it can get white hot. Let the contents melt into a liquid and then take the crucible out and gently tap it on something to shake the lead, etc., down to the bottom. Then let it cool and break the crucible. At the bottom will be found a piece of lead about the size of a coat button and of the same shape. Take this out and pound it up into a cube or little square block, so as to get all the sand and other stuff out of it. Then take a clean crucible and place it in the hole in the fire that the other one was taken out of. Place the cube of lead in a cupel, and lower it into the crucible with a thin strip of paper. Let it get quite hot or until it begins to fume or give off a little white smoke, and let it keep doing this for about an hour. It will gradually all grow smaller, until there is only a very small bead of it left which won't pass off. Take a small piece of silver (a shaving off a five-cent piece will do), and drop this on this bead and let them melt together; take out the crucible, and let it get cold. Then take out the bead very carefully and lay it on a piece of flat iron, and press a hammer down on it till it



is flat. Place it in a small vial, or bottle, or a tea cup, and pour a little nitric acid on it and heat it a very little. If there is only silver present it will all melt up in the acid, but if there is gold, there will remain a small black flake, which will reveal its true character by rubbing it with a knife.

This is all that a prospector requires to know, as if

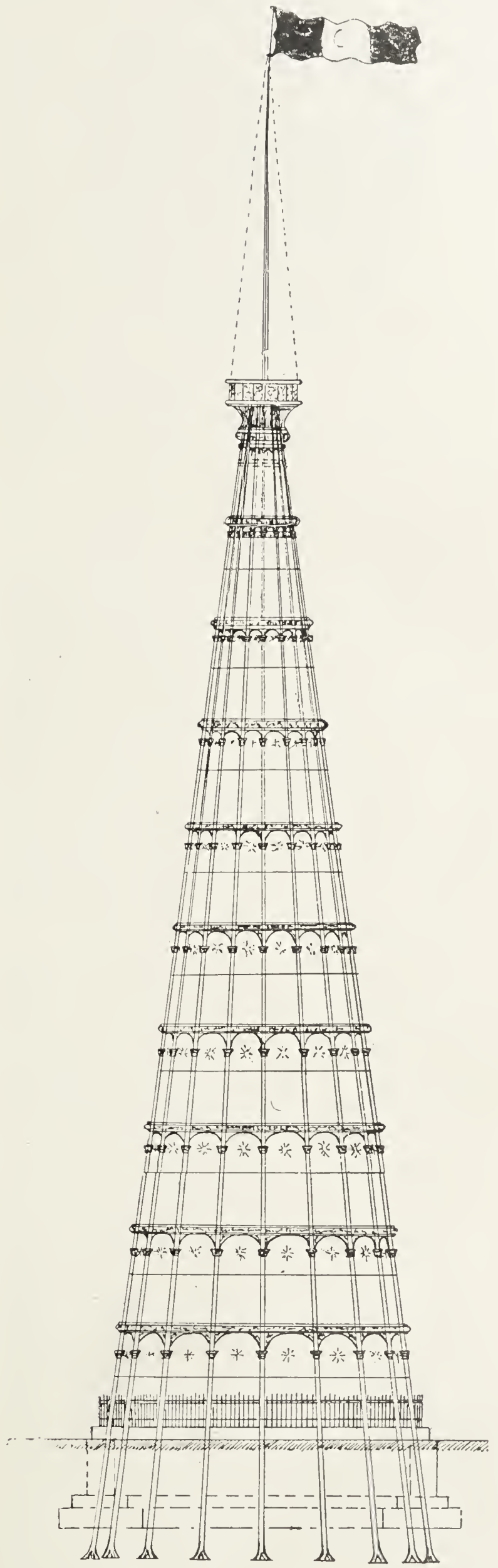
a mine shows gold at all it is worth something to the man who finds it. Any mine that shows gold under this test will run over four dollars a ton, and any mine showing this amount will pay to work it. Assays running over $15 per ton are not average assays, and not to be depended on. The prospector need not expect to find the gold sticking on in lumps; it does not occur in that form very often. Liquid tests, as a rule, can only be made by expert chemists.

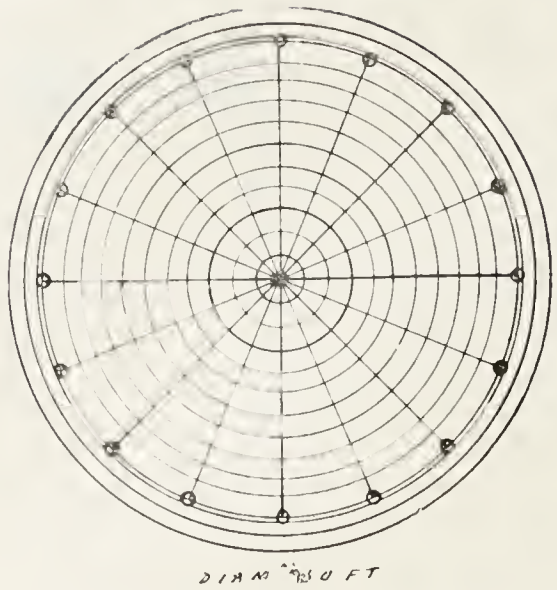
If the ore contains a small amount of arsenic, it cannot be tested by this method, as the arsenic would carry all the gold off with it in the form of vapor. The arsenic can be detected by heating the ore, when the arsenic is given off, and can be recognized by its smell, which resembles garlic. All ores containing a large amount of pyrites will have to be roasted before assaying. Ores containing arsenic can only be tested by an expert analyst, as I have myself seen ores which went as high as fifteen dollars in gold show nothing when tested by assay, so when an arsenical ore is met with, if it does not show gold by this process it should be analyzed. Gold when found in a free state is only in very small white-yellow grains, hardly visible under a magnifying glass. If the capping rock of a mine shows a large amount of iron or rust, it must have a little sand mixed with it to form a good slag. Other little points the assayer will find out as he goes along.

## PROPOSED VICTORIA JUBILEE TOWER FOR QUEBEC.

Charles Baillairge, city engineer of Quebec, has recommended to the city council the construction of an iron tower 150 feet high on the Place d'Armes, as a memorial of the Queen's reign. This would be 50 feet higher than the loftiest point of the Frontenac Hotel, the top having a "crow's nest" 10 feet in diameter, surmounted by a flagstaff, having a flag with the word "Victoria" worked into it. The structure, of which a plan is here presented, could be built very cheaply. and the effect of the fireworks and illuminations from such a tower are vividly and dramatically pictured by Mr. Baillairge, as follows:

"The crow's nest on the now proposed pyramid would afford a commanding view of the whole surrounding country, and in the case of an illumination with fireworks, a hundred rockets or more set around its periphery or two or three hundred of them in double or treble tiers, all slightly inclined outwards at an equal angle to the vertical, if simultaneously or together fired by electricity, and soaring skyward another hundred and fifty feet or more, would thus form a sheaf, a monster parachute, opening at some 600 feet above the St. Lawrence, and their component vari-colored stars lighting up the heavens and descending in a fiery shower upon the city, not this time out of God's wrath, as on Sodom and Gomorrah of old, but as a shower of blessings for a munificent reign of 60 years of good and noble deeds. Such a structure would be used on all festive occasions, each of its 160 arches lit by an incandescent light at night with a 10,000 candle power arc light at its summit, or a 100,000 c.p. one, if the city could afford it. Creeper roses might be made to grow around it, and in time to almost cover it, or at any rate it could be festooned with artificial flowers and a bouquet hanging from each of its component arches, diminishing in size as they ascended. On a gala occasion, its usually white drapery could be supplemented to form the 'red, white and blue' of the British, the





'tricolor' of the French; while on a day of national mourning, as when we lose our beloved Sovereign, it may be painted and draped in black or white and black, or all in white, as on the birth of another heir to the throne."

## THE MOTOR VEHICLE—IDEAL AND REAL.

Regular readers of THE CANADIAN ENGINEER need not be told that this journal is interested in the new development of inventive industry in connection with the autocar or horseless vehicle, and that we have faith in the outcome of inventive efforts along this line. Since the editor returned from England last autumn, and wrote his impressions, we have published nothing special as to motocycles, for the very good reason that no radical improvement has since been made. We think our readers may be interested in a review of the situation as it is at present, gathered from the various journals of the motocycle industry, from the published data as to tests, and from interviews with practical mechanics and electricians who are wrestling with the knotty problems involved.

Let us first say that the essentials for motocycle work are: (1) power, (2) control, (3) speed. These essentials are given in the order of their relative importance. *Power* must be sufficient for overcoming hills and holes, sand and snow, rain and ruts. The power required on a good level road for $2\frac{1}{2}$ tons of vehicle and load would be about 2.5 horse-power for a speed of eight miles an hour, or about 3.75 horse-power for a speed of twelve miles. To mount a hill, some parts of which may be on a gradient of 1 in 20, the 2.5 horse-power rises to 10.5 horse-power; but if a speed of three miles per hour were deemed sufficient for climbing the gradient of 1 in 20, only about 4 horse-power would be required. But for bad roads these quantities ought to be doubled, so that to take $2\frac{1}{2}$ tons of vehicle and load up a gradient of 1 in 20, at eight miles an hour, would require about 20 horse-power, or at low speed about 8 horse-power. These conservative figures, taken from an English engineer, should be kept constantly in sight by inventors; and it might be added that even on ordinary level roads there are occasional short grades much steeper than 1 in 20, whereas sidewalk crossings run 1 in 10. *Control* is important both as to speed and as to steering. In the Chicago contest one motorman became unconscious because of the great strain of manipulating the steering apparatus. *Speed* is the third element, but has no value except in conjunction with power and control. The more speed we get, the more urgently must we insist on control. High rates of speed may be permissible, even advisable, with an extremely perfect control; and it is possible that a method of control may be yet secured that is even more tractable than a horse; but it is not here yet. The control of electric vehicles, not being limited to fixed speeds, is preferable to that secured by differential and frictional gearings, both of which are antiquated, though the latter is advertised as a novelty. The practical difficulty with frictional gearing on an autocar is that there is insufficient grip when it is most needed, viz., when special demand is made for power.

The motive powers which have been tested on autocars may be named in order of merit: (1) *Explosives*, including petroleum, acetylene and gunpowder. (2) *Electricity*, primary and storage. (3) *Steam*. (4) *Compressed Air*.

It is next to impossible to get reliable data on autocars. Readers must winnow a bushel of chaff to get one kernel of wheat. The only really reliable mechanical data we have is that furnished by the judges in the *Times-Herald* contest in Chicago last November. The Duryea gasolene motor made the highest record on practically all points, and we may, therefore, take this as high-water mark up to date. What do we find? The vehicle (seating two persons) weighed 1,208 lbs.—and this, by the way, was the lightest of all the vehicles entered. Two runs were made with her on the testing machine, giving draw-bar strains of 83 and 88 lbs. respectively—these being the records of the motor while running under its best conditions. At these draw-bar strains, 1.10 and 1.16 horse-power was exerted at the rim of the driving wheels, at a speed of less than five miles per hour; a mechanical efficiency of 65 per cent.; a consumption of 3.64 and 3.24 lbs. of gasolene per h.p. per hour, giving a cost per h.p. hour at rim of wheel of 7.28 cents and 6.48 cents. As the Chicago judges remarked: "It is apparent that the heaviest pull exerted, namely, that with the Duryea vehicle, amounted to only 187 lbs., as compared to 400 lbs. which a single horse could exert. . . . For the purpose of determining roughly a probable value, an express horse of average type was tested by your committee, and without resorting to violent methods of persuasion, the maximum pull obtainable was found to be about 250 lbs. It is probable that 400 lbs. is about the maximum of a good horse. On the other hand, when the pull is light a considerable range of speed may be obtained, and the measure of the power exerted by the horse at all times may be obtained by multiplying the pounds pull by speed in feet per minute; dividing this by 33,000 gives the ordinary unit known as a horse-power." Taking this method of calculation with the Duryea motor, the best result is about half the draw-bar strain that a good horse could exert.

It is quite evident from the above figures that although the price of motor carriages ranges from $1,000 to $1,500, their actual efficiency for work on roads other than asphalt is less than that of a horse which could be bought for about $25. The only hope of popularizing the horseless vehicle, at least for the present, is by producing something infinitely better than an ordinary horse.

As to acetylene and gunpowder, these are two very desirable fuels if they can only be kept reasonably cheap, but thus far the indications are against this.

As to electricity from storage batteries, there are many advantages such as cleanliness, simplicity of manipulation and control, absolute safety, and absence from vibration; but as shown by the Morris & Salom

vehicle at the Chicago test, the difficulty is the low margin of power-supply, and the uncertainty of being able to accomplish your journey unless charging stations are established along the route.

It seems absolutely cruel that in an up-to-date article on the latest development in autocars we should have to mention steam; but many enthusiastic and intelligent autocarists, particularly in England, are proclaiming its superior merits, the Serpollet system being the prime favorite with the cult led by Sir David Salomons. The advantages of steam are, first, no trouble with igniter; secondly, a well-fitted steam engine is one of the most reliable machines made by man. The disadvantages relate to the boiler—danger from explosion, size, difficulty of keeping clean, the large amount of water to be carried, and the visible nature of the exhaust.

Compressed air has largely the advantages of the storage battery, with its most serious defect—lack of sufficient storage capacity. It has, however, all the advantages of the steam engine in its ease of control and certainty of operation, while it is absolutely free from all odors, and vibration can be reduced to a minimum. But the great difficulty and cost of supply, large bulk of reservoirs, and danger from explosion, put this power out of the race, at least in the meantime, except for very short services.

To sum up: there is not to-day, so far as we can learn, a single vehicle motor anywhere working under any of the systems above named, which can show an efficiency equal to that of good horseflesh for every-day work on all classes of roads. There need be no trouble from slipping when pneumatic tires are used; but we would impress on inventors that they should pay less attention to speed and more to the development of power so as to suit actual roads, and not ideal ones, under the impression that the roads will be made to suit the vehicles. The motocycle will be an important factor in bringing better roads, if it can be made to do effective work on present ones.

The difficulty of securing reliable data sufficient for this article has been so great that we can readily understand why the motor vehicle industry is now practically at a stand-still, the public having been disheartened by the great disparity between claims made by inventors and actual performance; but the best proof that motor vehicles are not yet on a commercial working basis is the fact that they are not doing work on our streets, and that first class opportunities, such as that offered by Elder, Dempster & Co., for the carriage of goods from Liverpool to Manchester, go a-begging.

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*For* The Canadian Engineer.

## CARE AND ERECTION OF SHAFTING.

BY G. P. CLAPP, MONTREAL.

A few simple rules for the erection and maintenance of line shafting may be interesting to manufacturers who are looking for strict economy and the best results obtainable in this department. In erecting new shafting, adjustable hangers should be selected, and strong enough to do the work required without springing. The width of bearings should be three times the diameter of the shafting. Where a number of pulleys and belts are used, bearings should ordinarily be ten, eleven and twelve feet between centres, for 2, 2½ or 3 inch shafting.

When large driving belts, from six to twelve inches wide, are to be used, a strong bearing should be placed on each side of the pulley. A neglect to provide for this important item will result in springing the shaft, and causing it to heat in the bearings, besides the liability of breaking from the constant vibration and eccentric motion, which always occurs when shafting is sprung out of line by stress of tight and heavy belting. Shafting should not be fully lined up until all machinery on upper floors is in position. When hangers are attached to floor timbers or ceiling, and the floors are then loaded down with machinery or material, the shafting will always be found badly out of line from the effects of springy floor and timbers. By all means avoid making a storehouse of buildings where line shafting is extensively used.

When convenient, shafting should be hung on posts having a good foundation in the ground cellar and running directly through the various floors; by this plan the floors may be sprung by varying loads and still the shafting will not be effected. Tallow or grease of any kind should never be used on bearings unless it comes in direct contact with the shafting. Piling grease on the box of a vertical shaft, stuffing it in the oil holes, or in the recess around the oil holes, in the caps of horizontal shafting, is a delusion and a snare. Only the grease that comes in direct contact with the shaft will melt until shaft and bearings become so hot that damage is done. The person whose duty it is to look after the shafting, will usually depend upon the grease doing the work that he should do with his oil can. Where the writer is employed, no one is allowed to use grease as cited above, without risking his position. More damage has been done to shafting and bearings by this practice than by any other known.

The size of shafting in its relation to its liability of heating and springing is one of great importance. Shafting too small for the work required leads to bad results, not simply from the width of bearings and size of shaft. Insufficient bearings, with a heavy tension on belting, causes the shaft to spring, and this brings the greater part of the strain on the edge of the bearings nearest the tight belt, consequently heating and cutting is the result. Writers on this subject often overlook the fact that there are other causes for hot bearings besides narrow boxes and small shafting. The fact is, bearings are not likely to heat providing oil can be kept between the two metals composing the shafting and bearings. With small shafting and tight belts, so much strain in proportion to the size of the shaft is brought to bear upon the bearings that the pressure makes an oil-tight joint, and the oil failing to penetrate between the two metals, heating is the result. If any good lubricant could be kept between the metals, heating would be almost an impossibility, but when the pressure becomes so great that the lubricant is excluded by an oil-tight joint then the trouble begins. The best and most economical results are obtained by running the main, or driving shaft, at as high a rate of speed as is consistent with safety. Experience teaches the fact that the source of power, such as engines and water-wheels, should be driven at the highest convenient speed. The following memo. for the proper size of shafting to transmit a given h.p. at varying speeds, may be interesting to some of your numerous readers. Size of shaft $1\frac{15}{16}$ in.:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Speed of shafting .... | 100 | 125 | 150 | 175 | 200 | 225 | 250 |
| H.P. developed.. .. | 10½ | 13 | 16 | 19 | 21 | 24 | 26 |

We are glad to be able to announce that the Ontario Government has refused the extension of time asked by the Canadian Niagara Power Co. to complete their power works on the Canadian side of the Niagara River, and work was commenced on the 30th April. The question of the status of the company in relation to other companies requiring power from the Niagara has been referred by the Government to the Court of Appeal, as also the question of the bearing of the Dominion charter granted to the Canadian Power Co. (the Welland River) on the American syndicate.

## THE OTTAWA WATERWAY TO THE GREAT LAKES.

BY A. J. FORWARD, OTTAWA.

*For* THE CANADIAN ENGINEER.

In *Scribner's Magazine* for January, 1896, a New York writer quotes approvingly the proposition of L. E. Cooley that "the line of export must follow the line of domestic transportation," and infers that "whatever merit Canadian routes may have from an engineering standpoint is entirely overbalanced by the fact that they run through a district which can furnish but very little freight in either direction." The fallacy of this statement, so far as regards the Ottawa route, may be readily shown.

During the season of 1895 the traffic of the Erie Canal, both eastward and westward, originating in New York State, was in the neighborhood of 600,000 tons, of which the following were the principal items: Pot and pearl ashes, 11,495 tons; barley malt, 24,698 tons; salt, 66,460 tons; stone, lime and clay, 240,859 tons. The quantity of coal distributed was 469,595 tons. Wheat from Buffalo and Tonawanda to points along the line of the canal amounted to 71,850 tons. From 1890 to 1894, inclusive, the movement of freight was as follows, according to New York Chamber of Commerce reports:—

| | From Tide-Water. Tons. | From Western States. Tons. | From New York State. Tons. |
|---|---|---|---|
| 1890..... | 1,304,274 | 1,194,017 | 470,549 |
| 1891..... | 1,175,536 | 1,186,521 | 502,589 |
| 1892..... | 1,120,704 | 1,329,706 | 478,380 |
| 1893..... | 567,659 | 1,586,238 | 675,380 |
| 1894 ..... | 960,320 | 1,437,293 | 259,059 |

The average annual traffic of the Erie Canal originating in New York State, or in other words, "derived from the district through which it passes," was therefore, during that period, only 473,191 tons.

For the period 1883-'93 inclusive, the average traffic of the Ottawa canals amounted to 692,173 tons.* Practically the whole of this originated along the Ottawa River, and the bulk of it was lumber. In 1894, out of a total traffic in that year of 562,010 tons, no fewer than 548,747 tons were the produce of the forest.† During the same year, out of 886,778 tons moved on the St. Lawrence, exclusive of the Welland, 537,982 tons were through freight, leaving only 348,796 tons as the traffic of local origin. From these figures it appears that the lumber traffic alone of the present Ottawa canals exceeds the entire traffic of the Erie canal derived from New York State, and is double the local traffic of the St. Lawrence canals. Such being the case when the canals extend westward no further than Ottawa city, it is reasonable to expect that the locally-derived traffic of the completed waterway, passing through the heart of the lumber country, and giving an additional outlet westward to Chicago and other lake markets, as well as better facilities to the east bound trade, will be at least twice or three times as great as that of the Erie Canal, without reckoning on anything else but lumber and other products of the forest.

The output of sawn lumber from the Ottawa district for 1895 was estimated at 627,000,000 feet. This at 600 feet B.M. to the ton, would amount to 1,045,000 tons. In 1892 the Georgian Bay region exported 184,500,000 feet of sawlogs, or 307,500 tons. Last year 307,000,000 feet (estimated), or 511,666 tons, went to the United States from that quarter. An open waterway from the lakes to the foot of Lake Tamiscamingue would result in the establishment of mills on the route to saw lumber for export to lake markets. A largely increased cut of timber would result, and the provincial revenues be correspondingly augmented without any injurious drain on our forest resources. Henry O'Sullivan, Inspector of Surveys for the Province of Quebec, in his report of surveys on the Upper Ottawa in 1895, says: "If there were mills on the spot, or if easy access could be had to this region, a great deal of good timber that is now left to rot could be utilized; but when we consider the distance, some seven hundred miles, that this timber has to be driven to Quebec market, second quality stuff cannot pay." Hardwoods, which cannot be floated for long distances, and inferior sorts of timber, would at once become merchantable, and go to swell the annual output, which it may be safely asserted might be doubled without trenching to any greater degree on the stock of pine of the better class. Where there is cheap transportation, such as the waterways would afford, the by-products of the forest are in the aggregate of greater value than the lumber and timber annually cut. Pulp and pulp-wood alone will furnish a large carrying trade. The market is extensive, and rapidly growing. European countries import over 500,000 tons of pulp annually. The report of the New York Forest Commission, 1891, states: "In the last eight years the amount of timber used for this purpose has increased 500 per cent. In 1891 the timber cut for wood-pulp in the great forests of Northern New York was equal to one-third the amount cut by the lumbermen. Already the cry of scarcity of pulp-wood is being raised in the United States, and they must soon come to Canada for almost their entire supply. On the head waters of the Ottawa, and northward over the height of land, are inexhaustible stores of spruce and poplar of the best quality The conditions for its local manufacture are also of the best. Three things are necessary to success, suitable wood, extensive water-power, and cheap labor. All these, as well as cheap transportation, will be found along the Ottawa River. Firewood to the extent of 1,064,812 tons was carried on Canadian railroads in 1893, and would furnish considerable traffic on the Ottawa. Tan bark, hop poles, telegraph poles, railway sleepers and ties, stave bolts, posts, pot and pearl ashes, manufactures of wood, etc., along with various minor products of the forest, would each afford a material addition to the traffic.

Without counting, however, on any increased output from any of these sources, there would be an annual traffic of 1,800,000 to 2,000,000 tons of products of the forest alone to draw from, and all "furnished by the district through which the canals run."

The opening of this waterway will aid to revive phosphate mining, and will eventually, by giving access to the markets, and reducing the cost of transportation, swell it to an industry of very large proportions.

There are two principal districts in Canada where apatite or phosphate of lime occurs. Both these are in the Ottawa Valley. The first, on the north shore of the river, consists of a belt from 12 to 25 miles wide, stretching northward through Ottawa county. Though of limited area, extending about 30 miles, so far as explored, it is notable for the richness of its deposits, both as to quantity and quality of product. The second district is in Ontario, having been developed principally in the counties of Leeds and Lanark, in the vicinity of the Rideau Canal, and covers a larger area than that on the north side of the Ottawa. Hitherto the impression has prevailed that the deposits are smaller and of poorer quality than those in Quebec. However, the report of the Royal Commission on the Mineral Resources of Ontario states: "Larger deposits have been opened up, particularly in one district, on the Quebec side thus far, but as regards similarity of occurrence and variation in quality (dependent largely upon intelligent dressing of the rock) identical conditions appear to prevail on both sides of the Ottawa. The quality of the higher grades of phosphate shipped from some of the mines along the Kingston and Pembroke Railway is as high as any produced in Canada." The depth to which the apatite extends is probably for all practical purposes unlimited. Shafts to a depth of over 600 feet still continue in good phosphate, and the vein matter, though irregular, is continuous.

* Canadian Stat. Year Book, 1894.

† Report Department Railways and Canals.

Mr. H. J. Wigglesworth, of New York, in addressing the Canadian Mining Engineers in 1895, said: "These phosphates are practically unlimited. Those who have studied their occurrence most carefully see no possibility of exhausting them. If all the population of Canada were employed there mining for ten years, the extent of the deposits would not be laid bare"

Here is evidently the basis of an extensive future industry. It is estimated that every year 1,500,000 tons of phosphate are taken out of the soil of the United States by its food crops. This must be returned to the soil in some form. For want of it many farms in the Eastern States have been abandoned as worthless, and whole States that could grow 30 bushels of wheat to the acre do not now average 15. Large areas in the older portions of Quebec and Ontario have been exhausted by continuous cropping. A judicious use of fertilizers would restore vitality to the soil. The worn-out cotton lands of Georgia, by the use of artificial manures, were raised in 20 years from a value of $3 per acre to $30. The same transformation might take place in Quebec. An almost unlimited home market for this valuable product will be developed in time. If the Ottawa waterway is to carry eastward the grain of the West, there must be return cargoes for the vessels employed in the traffic. What more beneficial occupation than to convey back to the soil the fertilizing elements of which it has just been depleted by the crops exported? Chicago, Cleveland, and other lake ports will afford markets every year more extensive. The only competition in those markets would be with the South Carolina product, which is handicapped by the long and expensive railway haul across the Alleghanies and westward. Vessels by the Ottawa waterway looking for return cargoes would carry very cheaply. Buckingham, Que., would be about the same distance from Chicago by water as Buffalo.

The adverse influences affecting Canadian phosphates are chiefly:—1. Low prices in the European markets, owing to cheapness of production in South Carolina and Florida; 2. General depression of the agricultural interests and low prices for farm produce; 3. High cost of apatite mining owing to the uncertainty of its occurrence, and the expense of selection or "cobbing"; 4. Frequent rejection of shipments that fail to analyze up to required quality; 5. Excessive cost of transportation; 6. Lack of home market.

The demands of the European market have been confined to the highest obtainable grades. These are used for mixing with low grade cheap material from South Carolina and elsewhere. The necessity for obtaining an 80 per cent. grade immensely increases the cost of production, and leaves a very large part of the product at the mines as waste material. If the United States and Canadian markets were available to the fullest extent, so that at 60 per cent. grade could be shipped, the output of each mine could be nearly doubled with the same labor, and the cost of mining and handling materially reduced. The present cost per ton laid down in the English market, ranges from $7 to $14, while it is probable that if markets on this continent were to take the low grade product, it could be loaded on vessels at Buckingham, at from $2.50 to $5 per ton. It may be shipped either after simply grinding the rock, or after manufacture into superphosphates. Magnificent water-power for grinding is available at the mouth of the Du Lievre. Iron pyrites for the manufacture of sulphuric acid can be conveniently obtained. To estimate the prospective tonnage to be afforded is, of course, out of the question; but there is every reason to believe it would be large eventually. About 6,000,000 tons have been shipped from the South Carolina deposits to date. European markets import 500,000 tons a year.

Another feature to be taken into account is that mica and other minerals occur very frequently associated with phosphate, where neither alone will repay working. So that whatever helps the phosphate industry will stimulate their production as well. Mica, graphite, asbestos, serpentine, pyrites, iron, and other mineral products of economic importance occur throughout the phosphate region, and would be extensively developed by the opening of this waterway.

The principal ores of the Ottawa region are magnetic. Hematite occurs very generally associated with magnetite, but usually in small quantities comparatively. From the well-known South Crosby deposits on the Rideau Lake northward to Arnprior, and extending across the river into Pontiac county, is a region described by mining experts as a hematite and magnetic belt whence valuable ores may be obtained in large quantities. Five miles from Ottawa, four miles from excellent water power on the Gatineau River, and only two miles from a shipping wharf, is the Baldwin mine. Ore from this has been pronounced "the best car-wheel iron ever used." The vein has been traced upwards of one and a half miles on the surface, there being at one place a solid hill of ore 100 feet in height. The amount of exposed or easily accessible mineral has been estimated at 100,000,000 tons. Ten miles north-east of Ottawa is the Haycock mine, from which very large quantities of ore may be obtained. Thirty-five miles west of Ottawa, and about four miles from the Ottawa River, are the Bristol mines, where there is an available supply of ore calculated by their mining superintendent, Mr. Symons, at over 30,000,000 tons. A report made for the owners in 1889 by John Birkenbine, a mining engineer of Philadelphia, among other things states:

"The extent of the ore body would appear ample to encourage the installation of a plant for smelting the ore, and personal investigations impress me with the belief that the Bristol mines should become as large a producer of iron ore as any of the ore bodies which I have examined either in the Province of Quebec or Ontario. Should mining operations be carried on upon an extensive scale, the location offers some peculiar advantages, owing to the fact that four miles south-east of the mines the Ottawa River encounters a limestone ledge over which it falls in picturesque rapids and cascades about forty feet. This water power, known as the Chats Rapids, could be utilized to advantage for producing power and compressing air, which might be carried, as at Quinisee Falls and Michigammee River, Michigan, to operate machines at the mines, or by converting it into electric force, it may be conveyed so as to produce power. Inspection and analysis would indicate an ore obtainable for smelting purposes approximating 60 per cent. iron, 2 per cent. sulphur, with phosphorus very much below the Bessemer limit; and when roasted this ore should exceed 60 per cent. of iron, with sulphur below one per cent. Taking into consideration the facilities now existing in the city of Ottawa, it appears to be the most advantageous location for utilizing the ores from the Bristol mines. An examination of the vicinity of Ottawa developed four very satisfactory points where blast furnaces could be located to advantage, and where facilities are offered for adding other manufacturing industries in the future. Some of these points possess special merit as to certain features, but all are convenient to transportation, and have ample cinder room, water, etc."

On the line of the Rideau Canal is the celebrated South Crosby ore deposit. Conveniently located along this waterway are also numerous deposits throughout the county of Lanark, as yet altogether undeveloped.

The numerous and rich mines of the Renfrew district and Central Ontario, and along the lines of the Kingston & Pembroke, Ottawa, Arnprior & Parry Sound, and Irondale, Bancroft & Ottawa railways, would also be very accessible from this point. Bog iron ores for mixing might be obtained from Vaudreuil, the present source of supply of the Drummondville forges. They also occur (in unknown quantities, the deposits being undeveloped) in Templeton township; in Hull township, only a few miles north of the city of Ottawa; near the river in Eardly township, 20 miles to the west; at various places along the Rideau, and throughout Lanark and Renfrew counties. Iron deposits are known to exist also in the vicinity of Lake Nipissing, on Lake Temiscaming, and elsewhere in the county of Pontiac. By means of the opening of the waterway the distance from the iron regions of Lake Superior and north of Lake Huron to Ottawa would be the same as to Cleveland.

The supply of ore which may be cheaply centred at Ottawa by the various waterways and railways is practically unlimited. A writer in the *Field Naturalist* several years ago asserted that—

"We have in the Hull, South Crosby, South Sherbrooke, McNab and Marmora deposits alone, in round numbers, 1,000,000,000 of tons, a quantity sufficient to yield 1,000 tons of ore a day for 3,000 years."

A statement so purely speculative must be taken for what it is worth. What is certain is, that deposits undeniably very large are already known, that the occurrence of iron is very general over a large part of the Laurentian area in the Ottawa Valley, and that the development work and exploration thus far done amount to very little more than scratching the surface here and there.

*Continued.*

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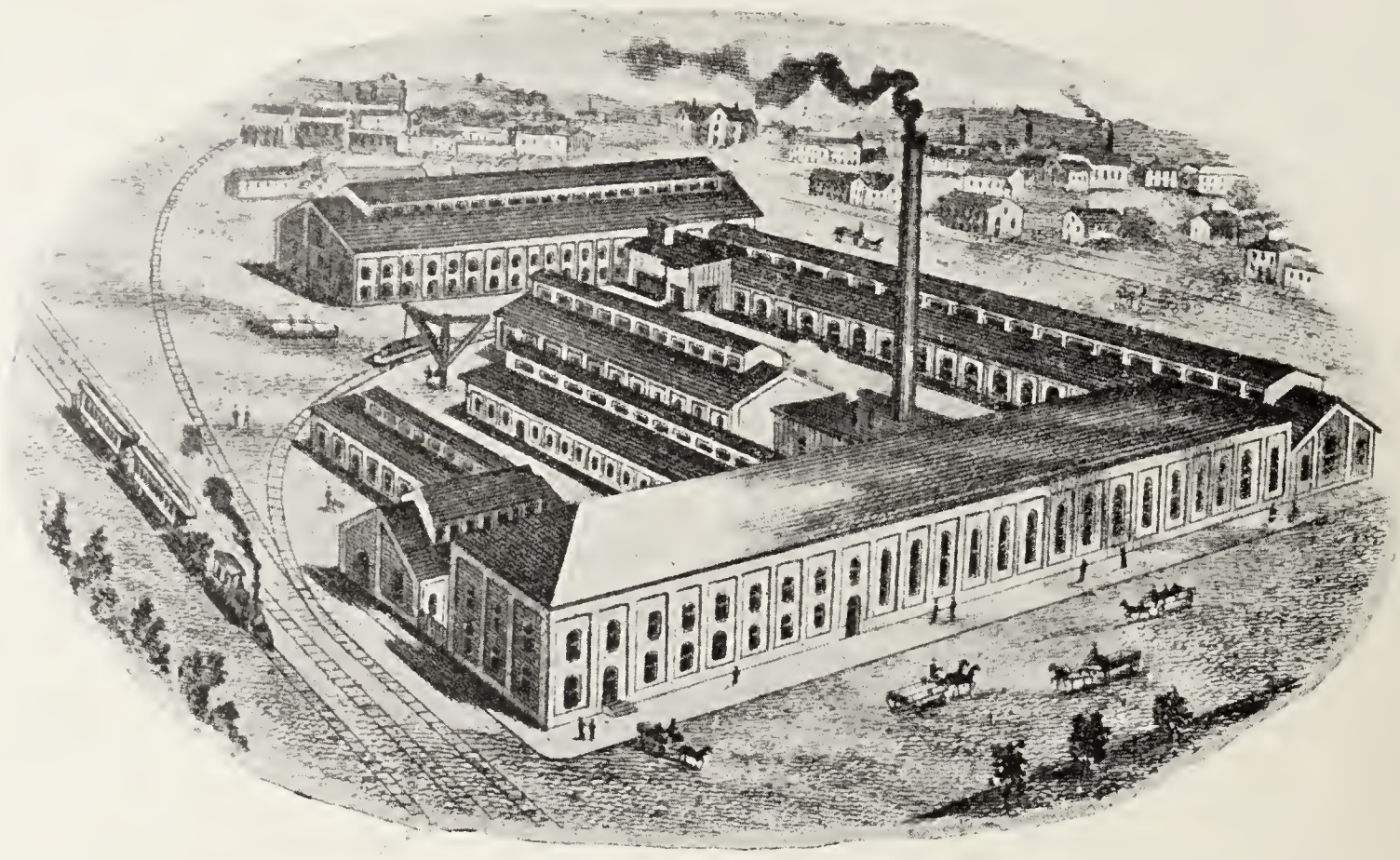
THE city council of Vancouver, B.C., has accepted an offer from J. A. Evans & Co., London, England, to erect a 6,500-ton smelter, as also a 250-ton refining plant. The firm is within a year to spend $600,000 on a building and plant capable of treating both lead and copper ores, and agree to employ no Chinese or Japanese. In return the city gives tax exemption for ten years, and a sufficient free public water supply. The smelter is to be of 500 tons capacity, and the refinery to be gradually, as required, brought up to 250 tons capacity. A vote will be taken on the proposal by the ratepayers.



WORKS OF S. MORGAN SMITH CO., YORK, PA.

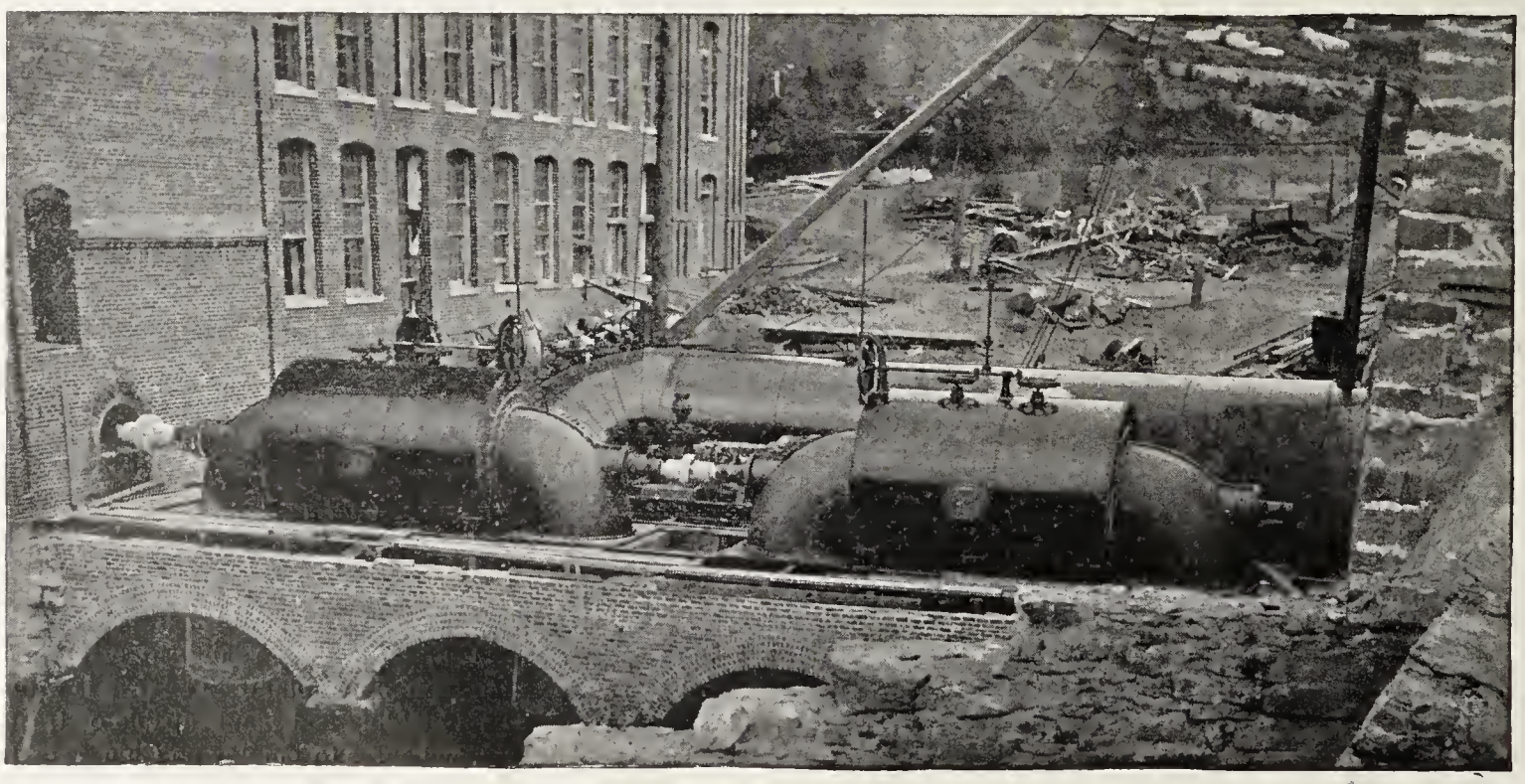
## M'CORMICK TURBINES.

York is one of the many noted manufacturing centres in Pennsylvania, and prominent among the manufacturing plants found in that city is that of the S. Morgan Smith Company. The buildings are chiefly of stone and brick, and are more than 1,100 feet long and cover several acres of ground. This plant has been built within the past six years, and equipped with new and modern machinery. The old shops, in another part of the city, formerly used by S. Morgan Smith in the manufacturing of water wheels and mill machinery, are used by other parties for the manufacturing of different lines of oods.

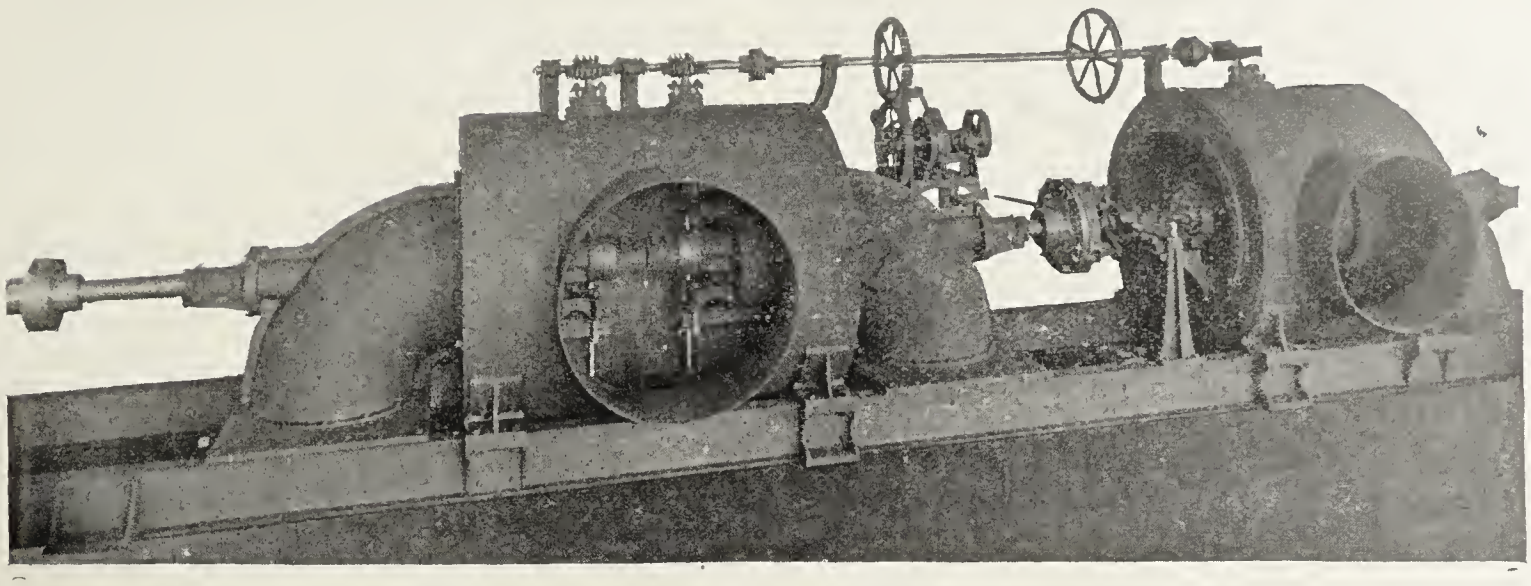
The many railroad tracks travelling cranes and elevators in use upon the premises and within the buildings are so well placed that all articles of machinery manufactured, whether in their crude or finished condition, up to 60,000 pounds weight, are handled as readily as a farmer handles his ploughs upon the farm, or the merchant his goods in the store. The plant is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers, and whatever else is needed in the construction of turbine water wheels, iron flumes, shafting, pulleys, gearing, steam boilers, etc.—some of the boring mills and pit lathes being large enough to allow of pulleys, rope sheaves and fly wheels being turned off and bored out, as great as 25 feet in diameter and six feet wide upon their face. There are also some remarkably large and fine machine tools for cutting and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face.

On looking through this shop and noting the many massive and modern tools it contains and the conveniences for handling every article manufactured, one readily understands why it is that the McCormick and New Success Water Wheels and other machinery for cotton, paper, pulp, flour and saw mills, so extensively built and sold by the S. Morgan Smith Co., give such excellent satisfaction.

The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. These facts explain why it is that the buildings composing the shops are so well constructed and arranged, why all the railroad tracks, travelling cranes, trolley lines, elevators, boilers, engines, cupolas for iron and brass foundries and great lathes and boring mills, are each and all seemingly located just in the right place. An important feature of the plant is the many windows in the ceilings and walls, flooding every department through the day with light, and at night the whole is illuminated with arc and incandescent lights, supplied by the company's dynamos. Large sums have been spent in improving and testing these water wheels, and in this way they know the speed and power of each size of their water wheels so perfectly



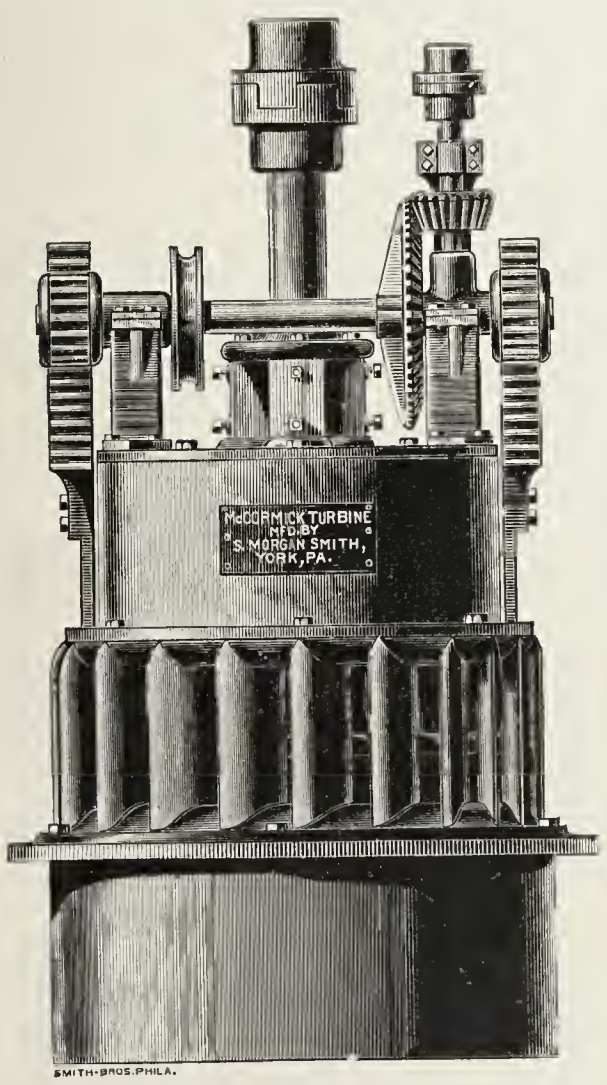
This engraving represents two pairs of horizontal 42-inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water wheel shaft, which extends into the mill, by three rope sheaves 10 feet in diameter, having 45 grooves for 1¾-in. ropes. There is also a 27-in. McCormick turbine on horizontal shaft, direct connected to a 1,000 gallon fire pump. This turbine also drives the dynamo. The combined power of these turbines is 2,355 horse. The water is supplied to the turbines by two pipes 10 feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No. 3 mill of the Clifton Manufacturing Co., Clifton, S.C.



This engraving represents one pair and one single 21-inch McCormick turbines, mounted on horizontal shafts in iron cases, operating under 64-ft. head, the ice manufacturing plant of Chas. T. Westcott, Baltimore, Md. By means of the Worrall friction clutch between the pairs and the single wheels, the latter can be disconnected from the former, when it becomes necessary, owing to lack of water, to operate but two wheels. A shaft about 50 feet long is connected with the shaft of the turbines and on the extreme end of it is a rope sheave, from which the power is transmitted to another rope sheave, located in the mill, about 200 feet distant. The water is supplied through a pipe about 125 feet long. The entire outfit was built and placed in position by this company.

that when informed as to what power is needed, and head of water available, they claim never to make a mistake in the size and number of water wheels required to operate the plant to the best advantage.

The McCormick wheel is the invention of John B. McCormick, who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery. A great many have been sold in Canada. The following is a list of some people in Canada who are using McCormick wheels furnished by this company:—Sault Ste. Marie Pulp and




Paper Co,, Sault Ste. Marie, Ont., 18 vertical 51-inch; E. B. Eddy Co., Hull, Canada, 2 pairs of horizontal 42-inch; Riordon Paper Mills, several different sizes; the Montreal Cotton Co., Valleyfield, Quebec, 2 60-inch, together with gears and shafting, and a duplicate of this order now being built for the same company; Municipality of Valleyfield, Que., a 60-inch, together with gears, shafting, friction clutches, etc.; Milton Pulp Co., Milton, Nova Scotia, 4 33-inch; Morgan Falls Pulp Co., New Germany, N.S., 3 33-inch; Sissiboo Falls Pulp Co., Weymouth Bridge, N.S., 1 45-inch, 1 27-inch, and 2 33-inch; Farnham Electric Light Co., Farnham, Quebec, 42-inch; G. K. Nesbit, Cowansville, Que., a 27-inch, etc.

## A NEW USE FOR SCRAP MICA.*

BY C. H. MITCHELL, TORONTO.

Mica is found in irregular crystals in almost endless varieties of size and color. It is one of the most perfectly foliated of all materials, the laminæ being so delicate in many specimens as to require the almost incredible number of 300,000 of them to form a thickness of one inch. Mica crystals are more or less seamed or cracked, so that often an apparently perfect crystal when split open parts and subdivides into a number of small fragments. This unfortunate characteristic has really been the cause of much of the disaster which seems so often to have dogged the steps of mica mining in this and other countries. It is bad enough to have to deal with any material which occurs in pockets which pinch out without warning, and which leave no particular indication or lead as to where it may be found again. If all the deposits of mica which have been found in Canada had produced crystals more or less free from cracks and flaws, most miners would have been content with their finds, and would not have been so much concerned as to whether or not it was a pocket or a true fissure vein. Then again many deposits of mica disclose a large portion of crystals twisted and destroyed to such a degree as to render their cleavage almost impossible. These together with the fragments already referred to, find their way to the dump, having thus far served no other purpose than to add very largely, and in some cases prohibitively, to the cost of mining the merchantable article. We shall, however, resurrect them presently, and I trust be able to demonstrate that instead of a loss, this hitherto costly waste may become a valuable by-product of mica mines. The proportion of waste or unmerchantable mica in every ton mined is very considerable. I do not know that the percentage of it to the ton has ever been approximated, but the evidence of a large number of miners would seem to indicate that it would average not far short of 70 per cent. of the total product. There are many instances I am aware where the average waste per ton is considerably less, but there are also as many cases where the percentage is as much higher, so that I think I am justified in venturing that estimate.

So far I have referred to mica in general, but now we must notice the particular groups of it in Canada. These we may determine chiefly by the variety and color of the material. There are, as I have said, almost innumerable variations of color and shade, from the nearly pure white to jet black, but for general purposes we may divide them into three groups—white, amber, and black. White mica appears to be very scarce in this country, as compared to the quantities of amber and black, and as it is almost perfectly transparent, it has always commanded a much higher price than the other varieties. I may say, too, in speaking of white mica, that there is a value for the waste or scrap of it, as when pulverized it has a beautiful lustrous appearance, which leads to its being utilized for wall-paper silvering and other decorative purposes. As, however, it does not appear to have been discovered in anything like the same quantity as amber and black in Canada, it has not as much interest to us as the commoner varieties. The great bulk of Canadian mica is included in all these shades of amber, silver, red and brown, which range from

* A paper read before the Ontario Mining Institute.

cloudy or milk white to dense black, which latter, as far as I know, has had no value whatever. I now come to this new use for waste mica; although we can use the refuse of nearly all these varieties, excepting badly twisted crystals, it is the soft amber and light brown micas which we prefer for our purpose. This is fortunate for all concerned, as it appears to be the most abundant. We find that by taking these scraps or waste pieces and subdividing them as finely as possible, and then quilting them between galvanized wire netting, that we produce a fireproof mat, flexible and clean, and a non-conductor of heat. It will be noticed that all these flakes are ribbed or corrugated, the object being to increase the number of dead air spaces in the mat, and also to add to its bulk without increasing its weight. The finer we are able to divide these flakes the more effective they become, as each one in itself is an effective non-conductor, so that the greater number we are able to get into a given space the higher the results are in checking the escape of the heat waves.

It will be seen that these mats, or quilts, are not only fireproof, but are flexible and elastic, which is a most valuable feature, as they will expand or contract with the iron they cover without cracking or flaking off. No doubt many of you have seen boilers covered with some of the old-fashioned cements, which being put on wet and allowed to set on the material, often crack and split to make room for the expansion of the material beneath. In time it will loosen and fall off, and requires constant patching to keep in order. The real value, however, in making these mats in sections, is that they can be removed whenever it is desirable to examine the shell of the boiler, and can be replaced easily and quickly without injury. As you will notice, they are secured to the boiler by means of hooks attached to iron bands, which are passed round the boiler under the mats. Besides this covering for boilers, the waste mica is made into sectional covering for all sizes of steam and hot water pipes, the only difference being that the mica is stitched between a wire core which fits the pipe, and an outer covering of canvas. The sections are secured to the pipe by lacing round the boot hooks, which are riveted up the seam at convenient distances. Covering for all sizes and shapes of fittings, including elbows, tees, crosses and globe valves, are also made and secured to the iron in the same way. These have been difficult to make, owing to the intractable character of the mica flakes themselves, as being very elastic, it was found hard to bend them to the various shapes. We found the same difficulty in making the flakes bend round the smaller sizes of pipe, but finally succeeded by separating them into different sizes in the same way as coal is graded, the larger flakes being used on the larger sizes, and so on down to the small half-inch pipe. Perhaps I may be allowed to refer here to the not unnatural idea that using the mica in this loose dry form it would be liable to shift or sag in the wire netting or canvas case. This, however, is not the case, for the reason that the flakes being of irregular shape, with the rough edges and ribbed surfaces, they catch and bind one another, matting together as hair does. As a proof of this, we may say that after nearly two years in constant service on locomotives, where there is probably heavier and more constant vibration than is found anywhere else, the mats have been found in perfect condition, and in the opinion of railway engineers are likely to last an indefinite number of years.

How vast the market for this material is may be imagined, when I remind you that every locomotive in use the world over has to be protected with some substance; that every steamer that puts to sea has boilers which require hundreds of tons of coal to feed them (in one of the great battleships of Great Britain lately launched, there were no less than 48 boilers), and that every stationary steam plant has a boiler or a battery of boilers, which require covering to minimize the loss of steam and power by radiation. How great this loss is few manufacturers, or indeed engineers, seem to realize. As you of course know, it is occasioned by the condensation of steam, that is, you allow the steam which you have generated often at great cost of fuel to cool off and condense by allowing the surface of the boiler and pipes to remain exposed to an atmosphere many degrees colder than they. With steam at 75 lbs. gauge pressure, it has been estimated that the loss of horse-power on different sized pipes uncovered is about as follows:—

| | | | | | | |
|---|---|---|---|---|---|---|
| 2-inch | pipe | 1 | horse-power | lost | for every 132 | feet long. |
| 4 | " | 1 | " | " | 75 | " |
| 6 | " | 1 | " | " | 46 | " |
| 8 | " | 1 | " | " | 40 | " |
| 12 | " | 1 | " | " | 26 | " |

So that when you complain that you cannot get power out of your engines, or that the boiler seems too small for the job, you may solace yourselves with the thought that it is very often because you don't know enough to keep your steam dry. An argument often heard among mining men is that as many of them use wood for firing their boilers, it is not so much consequence if it does take a little more of it to keep up steam. Suppose that is true, it is difficult to believe that it is wiser to tie down the safety valve and pile in wood to carry steam through long runs of pipes than to remove the necessity of doing so.

Another use for this waste mica is for fire-proofing. Mica, like everything else, will fuse if there is heat enough, even "the elements will melt with fervent heat"; but it will stand an almost incandescent heat without injury, and for that reason it is a very valuable substance for fire-proofing. Considerable quantities of it have been already used for protecting smoke flues, kilns, etc., and in some factories the underwriters have reduced the premiums after the flues have been insulated with mica. In this connection, it is not without interest to refer to the fire risk in some mines from unprotected steam pipes. I have heard that a serious fire occurred in a mine lately in Canada, which was directly attributable to a live steam pipe which ran in close contact to a wooden sheeting or boxing, and which subsequently took fire. It is very questionable whether a fire could be started from steam heat alone, but it is perfectly certain that wood may become so charred and calcined from contact with a live steam pipe, that a drop of oil or grease falling on it would quickly cause combustion. So that here again we find a use for mica. I cannot refer in detail to all the other actual and possible fields and usefulness for this hitherto despised waste product of our mica mines, but I must not leave the subject without touching on its qualities for resisting the other extreme of heat, namely, frost. It is said extremes meet. They do in this instance, for the identical covering made for fire-proofing gives splendid results in frost-proofing, and I have no doubt at all that mica will shortly be used for insulating cold storage chambers. Being free from organic matter to mold or smell, it will not taint even such susceptible commodities as butter or milk, not the least valuable of its advantages.

As those interested in mines and mining, you will doubtless enquire what effect this discovery is likely to have on the mica industry in Canada? This altogether depends on the demand. If it increases as it is doing now (the sale of it advanced 98 per cent. last year), very large quantities indeed will be required. I believe that while this new industry may not justify mining solely for its requirements, yet every ton of waste or refuse used in it means so much less cost of mining, and so much more profit in the year's business. It should make a considerable difference to the expense of mining, if in the future it is known that by simply laying aside in some protected place the waste and scrap which has hitherto been consigned to the dump, a certain amount of revenue may be earned which will lessen the general expense of mining.

The building up of industries in Canada which use as their base raw material produced entirely in this country, must be of ultimate benefit to the general community, and I think we must all deplore the conditions which appear to result in so much of the raw material of this country being shipped out of it, to benefit the towns and villages in the countries in which it is manufactured. We must recognize the enterpise and pluck of foreigners who come to this country and develop our latent wealth, but we must also deplore the fact that it often results in the large profits of the enterprise being carried away and spent amongst other peoples. The profits of much of our Nova Scotia coal mining is not unappreciated in Boston; the great lumber mills of Michigan know something of the value of Canadian logs. The paper pulp mills of the United States are not indifferent to the wood-pulp of British America, and even distant Spokane has associated the gold mines of British Columbia with many a new brown stone front in that city.

## GOLD QUARTZ MINING IN CANADA AND VICTORIA, AUSTRALIA.

BY F. HILLE, M.E., PORT ARTHUR, ONT.

Dr. A. R. C. Selwyn, in a paper read before the Canadian Mining Institute, published in full in the *Canadian Mining Review*, and in a synopsis of the same paper in THE CANADIAN ENGINEER, entitled "Gold Quartz Mining in Canada and Victoria, Australia," tries to give us a picture and comparison of the gold mining industry of both these countries, and comes after lengthy argument at last to the conclusion that they could not be compared with each other. "For the reason," he says, "Canada is essentially an agricultural and pastoral country, and it is very unlikely that it can vie in gold produce with the smallest province of Australia." Well, then, if this is the case, in the Doctor's opinion, why then make comparisons? He tells us he did it because "it is only by knowing and comparing with results elsewhere that we can gain a true and accurate knowledge of our own results and possibilities." This is cor-

rect when the fundamental conditions are equal, and we have a true and accurate knowledge of both subjects here—our resources and those of Victoria. But let us see if these conditions are equal:

Victoria's geology has long been known in detail; ours very far from being so as yet.

Victoria's economical geology is looked after by the different Government departments very attentively; ours was not till lately.

Victoria's climatic condition for all year outdoor work is better than ours.

And when we add to these considerations the Doctor's belief in the great difference in the geology and occurrence of economic minerals in both these countries, then surely any person must be at a loss to see the reason and utility of the Doctor's comparisons. But we learn further from his exposition that he wants to give us in these days of booms cold facts about our mineral resources, "to warn us of that most pernicious and meanest of lies—half the truth." This is undoubtedly very good to guard our material interest, but I question very much if he is able to give us cold facts, if he is possessed of a true and accurate knowledge of our possibilities. Why? Because he visited only a very small part of our districts, and his former staff had no orders from him "to waste time in economic geology." What do we know through the Geological Department, and especially under the guidance of Dr. Selwyn, about Western Algoma in regard to ore deposits, or their genetic relation to our rocks? Nothing! Yes, even the report on that part east of Rainy Lake to Sudbury is not yet published. And the Doctor tells us that he can give us true but cold facts! It is indeed to be lamented that he, although for many years director of the Geological Survey, has kept back this country through an inexcusable prejudice, which originated in his belief in his infallible gift of prognostication. Instead of concentrating the forces of the geological staff, and surveying those districts which were more populated and of easier access, and laying more weight on economic geology, he sent the gentlemen of his staff to the inaccessible, uninhabited and uninhabitable regions to the north. Of course to whose benefit could it be to know and learn the names of those barren rocks in the western part of Ontario, and barren they are, so he believes. And he must be correct, because he informs us he had also foretold the great possibilities of the Victorian gold fields, and further also those of the Nova Scotian, because the rock formations were identical with the Victorian. This prognostication reminds me of the effort of Sir R Murchison, who predicted in 1844 the gold occurrence in Australia, because certain rocks from that country showed similarity with some in the Ural Mountains.

Everyone who has an idea of the formation of veins knows that gold, or other deposits, are of "local" occurrence. We find similar or even identical geological conditions in many parts of the world, but do we find now in every instance ore deposits of the same character in these rocks? No, not by any means. This brings to my memory a similar incident which I observed last year. I had a gentleman of our fraternity from one of the south-western States with me in one of our western districts for the examination of some gold properties. His first question was whether we had porphyries in this country. The reason of his asking was very easily discovered, when I considered the occurrence of gold in his country being in the porphyry. But now let us see if the Doctor had not been equally justified in comparing the geology and ore deposits of our Western Ontario districts with the Victorian, as he did with the Nova Scotian. If he had examined our rocks somewhat more closely he would have found them to be very similar to the Victorian, if not in many instances identical with them. The latter deposits occur, as it is in most instances here, in the metamorphic rocks in the neighborhood of intrusive granites. Now, why not be consistent, and give us the same benefit of his prognostication as Nova Scotia, if he is so well versed with our geology? The Doctor said among other things: "It seems unlikely that the history of gold mining in Canada will differ from what it has been in other countries and under corresponding geological conditions." Well then Canada must have a good future, and could be well compared with Victoria, according to Dr. Selwyn's theory, because the geological conditions correspond very well. Again he says: "What the effect of the opening of new ground, better mechanical and chemical methods and appliances may be, we have yet to learn, but it is not likely that in the next thirty years an equal amount of gold produce will ever be recorded." There we have again the prognosticator. How does he know that there will not be more and more extensive gold placer and quartz mining ground found? Already we hear of new placer regions, and extensive trials are going on to win the fine gold in the Saskatchewan and other rivers. From season to season we extend by prospecting the gold bearing areas. Those in Victoria cannot be compared in extent with ours in Ontario, not to speak of the Western Provinces, and I have no doubt that by sufficient influx of money and a little more enterprise on the part of our people, we shall succeed in the same way as Victoria. Yes, we would be so far now if the former director of the Geological Survey had shown the same interest for our mineral industry as the Victorian authorities have done and still do, by sending qualified mining engineers into the different mining camps for exhaustive information in regard to the genetic relation of the ore deposits to the various rocks. These informations and reports contain valuable advices in mining and milling operations. If we had imitated this wise practice, our industrial conditions would look quite different to-day.

Not even the reports are published, with the exclusion of the Seine River and Shebandowan sheet, for whose early issue we have to thank Dr. Dawson, and neither are the maps of West Algoma published yet. Now can anybody tell me what good they will do to the development of our districts and provinces, when they are published two and even three years after the surveys are made? And when they are available to the public, of what benefit are they to the prospector? Do they tell or point out to him where and in what formation he can find the different economic minerals and metals, and in what relations they stand to the different rocks? Economic geology should go hand in hand with stratigraphical or structural geology; only then is the latter of practical value. If Dr. Selwyn had done more in this regard in our western districts he would have now a better knowledge of them, and would have perhaps reconsidered the passage in his paper that Canada "was essentially an agricultural and pastoral country." The Doctor forgets that the times of the old miners are past; as dynamite has superseded black powder and the fire setting methods, so has the air drill taken the place of the tedious hand-drill. Mankind is too busy, and time is too valuable—we want to see results as quickly as money can bring them about. We cannot wait for the old miner any longer, "till he is done with his tunnel in a hill-side." For this the "new miner" needs money, and to procure it he has to follow the custom of the times, to show what he has to sell, and the more truly and openly he does it the better for him and his customers.

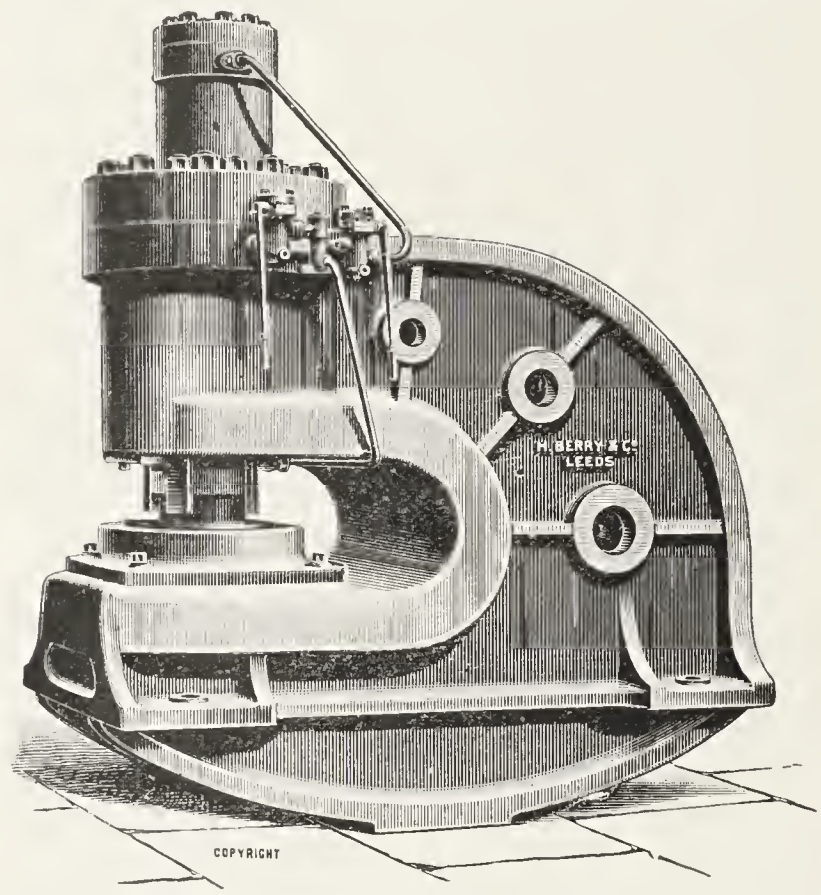
Dr. Selwyn compares the production of gold in Canada, and especially of British Columbia, with that of Victoria. How far he is justified in doing so we shall see. The earliest production of gold in British Columbia came principally from placer workings, very little from quartz mining, as in the case of Victoria. In the year 1858 it produced 40,275 ounces, and increased rapidly to 1863 up to 223,632 ounces, but fell then the more the Fraser River and other diggings were worked out, very gradually down to the year 1894 to 21,275 ounces. But since quartz mining operations commenced there more systematically and energetically the production increased in the year 1895 nearly 300 per cent., that is to 62 436 ounces. Now I have not the slightest doubt that we shall see in the next few years the production climb up to that of 1863, if we consider that there are daily more mines opened up, and as I mentioned above, new and more extensive placer ground to be discovered, and we may yet see the production of gold in our North-West reach that of Victoria. Now, if we look at the Doctor's list of Victoria's gold production, we observe here exactly the same falling off as we have seen in the British Columbian. The largest amount was mined in the second quinquennial period; so it was in our Province, and decreased then to the year 1891, when most of the placer mines were worked out, and would have kept on decreasing if the cyanide process had not enabled them to work their old dumps over. Victoria has undoubtedly reached the height of its gold production, while British Columbia is only beginning now with gold quartz mining, and also with new placer ground. The same can be said of Ontario. Very little is known of its vast areas of gold-bearing rocks; but what is known justifies us in saying that it has as good a future as Victoria had 40 years ago as a gold-producing country. Dr. Selwyn exemplifies a few old prospects worked in the beginning of the seventies, in the Lake of the Woods district, and belittles these mining ventures; at the same time he tells us that they were examined by a gentleman of the geological staff, and creates the impression as if Mr. Coste's report had been unfavorable. Exactly the contrary is true. He commented unfavorably on the different companies' method of working, but had no fault to find with the veins. A number of the latter are undoubtedly good true veins. The principal reason for discontinuing the work on these mines was the same that has characterized also the later mining periods of the Lake of the Woods: Insufficient capital, lack of knowledge of mining and of geology, complete ignorance of metallurgy, and employing of inefficient milling machines, and this latter is up to date

the case. Since more capital has flown into that country, and more systematic mining practiced, the Lake of the Woods is showing up very well indeed. On superficial examination, the geology of that country seems complex, but by repeated visits and closer study a person can read more intelligently those ancient hieroglyphics of nature. The same can be said of many other places in our Western Ontario districts that are rich in different minerals, which should have been known long since, if the former director of the Geological Survey had sent his staff there ten or twenty years earlier.

In summing up what I have said about the part that Dr. Selwyn has played in the development of our Western country, and the information he has gathered in regard to our ore deposits, I must deny him the right to speak publicly and authoritatively on the possibilities of this country.

## HYDRAULIC MANHOLE PUNCH.

The accompanying engraving shows a powerful hydraulic manhole punching machine, capable of punching at a single operation a manhole 27 x 22 inches, out of a piece of metal three-quarters of an inch thick. This machine is one of the numerous special tools




HYDRAULIC MANHOLE PUNCH.

made by Henry Berry & Co., the well known manufacturers of hydraulic machine tools, of the Croydon Works, Hunslet, Leeds, England This machine is invaluable in ship yards, boiler shops and similar establishments, and is made in several sizes.

## THE NEW CROCKER TURBINE.

It is manifest that the evolution of the turbine is keeping pace with advance in other lines of mechanical art. A decade ago, iron wheels were frail in construction, of small capacity, and uncertain in results. A glance at any old water-wheel catalogue will reveal the progress. A 30-inch runner was tabled to develop, say, 50-h.p. under 20 foot head; the modern turbine gives nearly three times this power, and the efficiency has been raised from 15 to 20 per cent. also. These important results have been realized by men of natural talent, aided by practical experience gained by close observance of the results attained by the various types of wheels in use. It is a curious feature that no turbine of purely mathematical or scientific origin has held a place on the market. The horizontal system of installing turbine plants is highly successful. Under more than moderate falls, this is said to be the most desirable plan. The removable step-socket now used with vertical wheels has, however, greatly lessened the difficulties experienced heretofore with that mode of setting. The turbine style furnished the most economical power and the greatest percentage of the force expended. With it, electrical energy can be generated at the lowest possible cost. Thus, every water privilege having reasonable constancy, is destined to become valuable and available for the development of local or distant enterprise.

The subject of this article, the Crocker Turbine, is claimed to embody all the desirable characteristics required in the diversified industries of to-day. The runner, or wheel proper, is a model of design and scientific construction. It unites ample strength in a union capacity, and the highest efficiency obtainable. The gates and chutes are so formed and secured to the casing as to be easily operated, even under high heads, which admits of perfect regulation by ordinary governor. The surface formed by gates and chutes introduce the water to the wheel in solid streams, the full height of bucket, thus producing high part gate results and uniform speeds under variable conditions. Every particle of water is directed on to the buckets; there is no leakage through the crown plate to the wheel vents, which is always said to occur when cylinder gates are used. These turbines are manufactured by the Jenckes Machine Co., Sherbrooke, Que.

## ESTIMATES BROUGHT DOWN BY THE DOMINION GOVERNMENT.

| | | |
|---|---|---|
| **RAILWAYS.** | | |
| *Intercolonial Railway*— | | |
| Increased accommodation at Halifax | $135,000 | |
| Extension to Halifax cotton factory | 40,000 | |
| Other equipment | 173,000 | |
| | | $348,000 |
| *Prince Edward Island Railway*— | | |
| Improvements | | 19,000 |
| **CANALS.** | | |
| Soulanges—Construction | | 1,250,000 |
| Cornwall—Enlargement | | 185,000 |
| do Converting basin into dry dock | | 15,000 |
| Farran's Point—Enlargement | | 375,000 |
| Rapide Flat do | | 115,000 |
| Galops do | | 1,635,000 |
| North Channel - Straightening and deepening | | 375,000 |
| Galops Channel do do | | 50,000 |
| River reaches | | 50,000 |
| Lake St. Francis—Removal of boulders, etc. | | 75,000 |
| Trent—Construction | | 650,000 |
| Sault Ste. Marie—Construction and equipment | | 75,000 |
| Lachine—Enlargement | | 216,000 |
| do Deepening river at St. Pierre | | 40,000 |
| Lake St. Louis Channel—Straightening and deepening | | 86,000 |
| Grenville—Enlargement | | 90,000 |
| To pay George Goodwin final estimate and award of Walter Shanly | | 45,696 |
| *Chambly*— | | |
| To complete drainage works and culverts at St. John's, Que. | | 25,000 |
| *Ridcau*— | | |
| New Swing Bridge, Ottawa | | 10,500 |
| *Welland*— | | |
| Pier at Port Dalhousie | | 20,000 |
| Fender works for new bridges | | 18,500 |
| *St. Lawrence Ship Canal*— | | |
| Improvements | | 200,000 |
| *River Kaministiquia, Ont.*— | | |
| Improvements | | 18,000 |
| **HARBORS.** | | |
| *Nova Scotia*— | | |
| Various wharves and breakwaters | | 55,100 |
| *Prince Edward Island*— | | |
| Piers, wharves, etc. | | 73 800 |
| *New Brunswick*— | | |
| Wharves, dredging | | 33,500 |
| *Quebec*— | | |
| Piers, breakwaters, wharves, dredging | | 73,800 |
| *Ontario*— | | |
| Wharves, dredging, piers | | 306,000 |
| *Manitoba*— | | |
| Wharves, etc. | | 11,500 |
| *North-West Terrritories*— | | |
| River and bridge works | | 5,000 |
| *British Columbia*— | | |
| Dredging, wharves | | 49,250 |
| **PUBLIC BUILDINGS.** | | |
| *Nova Scotia*— | | |
| Halifax drill hall | | 110,000 |
| *Ontario*— | | |
| Arnprior post office | | 15,000 |
| *Manitoba*— | | |
| Portage la Prairie post office | | 20,000 |
| *British Columbia*— | | |
| Victoria post office | | 53,000 |

## THE MINES OF ONTARIO.*

BY J. F. WHITSON, O.L.S.

I will endeavor to give some of the information I gathered during the two years I was an active explorer in the Rainy River, 1890-91, and from what I have gathered during the last few years, when I have been somewhat closely connected with the mining interests of that district, so that you may have some idea of the great mineral wealth of Ontario's most westerly possession. I am fully alive to the responsibility resting on anyone writing about a new mining country, and shall hew closely to the line, so that no one going to the new field shall be disappointed in not finding things fully as good as stated in this paper, but rather be able to say the half has not been told.

Indeed, it would be very difficult to overestimate the possibilities regarding the mineral wealth of New Ontario. Up to the year 1856, when Napier made his first exploration trip through the district, but little was known of the new region, and, in fact, that statement would almost hold good at the present time with reference to a great portion of the country lying even south of the C.P.R., between it and the northern boundary of Minnesota, while the country to the north of the railway is as yet a closed book. The building of the great railway, the C.P.R., has done much to open up the western country, and no portion of Ontario has been more benefited than has this new district. It occupies that great stretch of country lying between Thunder Bay district and the Province of Manitoba, 192 miles in width, and extending from the northern boundary of Minnesota, north to Lake Seul, 175 miles in length, on its eastern boundary, and averaging not less than 125 miles, and comprising an area of nearly 20,000 square miles, or about 12,000,000 acres, including within its limits the Lake of the Woods, with its 1,400 or more islands; Rainy Lake, with its 600 miles of coast line, or more than that of Lake Ontario, Manitou, Wabigoon, Eagle, Lonely, and more than a thousand other lakes, in fact, one might call it "the land of a thousand lakes."

The general physical characteristics of the country are very similar to those found in other glacier-swept Archean tracts, such as the north shore of Lake Huron, Muskoka, or Parry Sound. In few places is the country as mountainous as the north shore of Lake Superior, or as difficult to explore as the region north of Lake Huron. Within the district are to be found many large and magnificent streams—Rainy River, 80 miles in length, with an average width of not less than 500 feet; Winnipeg, English, Seine, Manitou, Eagle, and many more streams are quite navigable for large boats in places. The geological formation of the district is either Laurentian, Huronian or Keewatin, and post glacier, the Laurentian rocks predominating. The most recent, the clays and sands, form the agricultural section of the region along the Rainy River and around Wabigoon.

Of the total area of the district, nearly 5,000 square miles is covered with the Huronian, or gold-bearing, rocks. It will, therefore, be seen what a vast field there is for prospectors in this new district. I believe that this new Ontario will yet be one of the richest gold districts in the Dominion within the next ten years; yes, on the continent. The success which has attended mining in that thinly-populated and undeveloped condition of the country in the past two years is but an evidence of the great success which awaits the future exploration, not only for gold, but for other minerals.

The history of the district since attention was first drawn to it by the discovery of gold, about fourteen years ago, shows that nearly all the exploration to which the country has been subjected, up to within the last 18 months, has been confined to the shores of the Lake of the Woods, Rainy Lake and a few of the larger streams tributary thereto. Few prospectors have ever penetrated into the interior; in fact, this will apply even up to the present time, they having contented themselves in prospecting the main waterways, which are easy of access, going back but a short distance inland, so that at the present time but a very small portion of the country, even convenient to the C.P.R., or the larger lakes, has as yet been even partially explored.

Long after the first discovery of gold on the Lake of the Woods, very little development work was done, except on the Pine Portage and Sultana mines; this was partly owing to the want of capital, but more particularly to the belief that there was little gold to be found in the district. The good results attending the development of the Sultana mine have done much to encourage others to prospect and develop discoveries, and in nearly every instance where development work has been done the results have been highly satisfactory, so much so that during the last two years prospecting has been very active, and has resulted in the discovery of a great many veins of gold-bearing quartz, many of them undoubtedly rich, and will yield large profits when mined.

Mining, properly speaking, can scarcely be said to have more than begun, except in a few cases. Prospecting, however, has been very active, and many of the leads are well stripped and opened into. No less than 100 different mines are being developed or partly so, so that with the increased shipping facilities, the building of new roads by the Government, the investment of English and foreign capital in the district of late, it is confidently anticipated that this year will see extensive mining operations and good returns therefrom; in fact, there are no less than half a dozen stamp mills, either being shipped into the district or being erected, at the present time.

The good results of the last six months' mining have given to those interested in the future of the Lake of the Woods unqualified satisfaction. Everything, with few exceptions, has gone to show that their confidence has been well grounded. Those who were at first most skeptical as to the permanency in depth and richness of the deposits have candidly yielded in the face of the unquestionable evidence offered them in the splendid showing of such mines as the Sultana, at a depth of 400 feet, with an enormons body of rich ore at that depth, and every appearance of an unlimited quantity, which can be mined and stamped with even a 10-stamp mill at less than $4 per ton. The Regina mine, at a depth of 286 feet, with a similar mill, is producing gold at nearly the same cost per ton; other mines in the district, such as the Mikado, Yum-Yum, Cornucopia, Goldcoin on Shoal Lake, Gold Hill, Black Jack, Princess, Scramble, Trojan, Triumph, Bath Island, and many others on the Lake of the Woods, are producing large quantities of rich ore, and there is scarcely the shadow of a doubt but that most of them will be pay mines. The Mikado yielded 136 tons of ore at first clean up, while the Saw Bill, Lake Harold, Hawk Bay, Folger and Hammond are all producing large quantities of ore, and are undoubtedly splendid mines. On Seine River the Foley mine has a 20-stamp mill at work, and can work the ore at $3 per ton. They are down several hundred feet in the shaft, and there is every appearance of it being a permanent mine. The Porcupine, the Weigand, Proudfoot, and many other mines on the Seine River, are turning out very successfully.

Rainy River, as a gold district, can be conveniently divided into five sections—first, and probably the most important, is the Lake of the Woods section, including all the country northwest of Rainy Lake and around Shoal Lake; west of the Lake of the Woods, comprising an area of not less than 2,000 square miles, in which there has been over 1,500 claims surveyed, and the Rainy Lake section. Gold was first discovered on a small island in Rainy Lake on the Minnesota side of the line, in the fall of 1893. In the spring of 1891 was found a small nugget of free gold on Hunter's Island. Since that time the prospecting has been very active and several good mines located, on which stamp mills are now working. The Manitou section, comprising the country round Manitou, and Wabigoon and Eagle Lakes, in which there are over 300 locations surveyed and several good veins, well developed, and from all appearance this has every likelihood of being a very good gold district. One of my Indians, in 1890, found a sample, showing free gold, at the head of this lake, and I arranged with him to take me to the place, but a few hours before starting the Indian got drunk, and I have never been able to get him sober enough to go out.

The Saw Bill Lake section, including the country around Saw Bill and Harold Lakes, in which about 125 claims have been surveyed; this is one of the most promising sections in the district and contains the great Folger and Hammond dyke from 10 to 300 feet in width and nearly a mile in length, and which appears to assay from a few dollars per ton up to $100 or more; this is probably one of the largest quartz ledges ever discovered in the province, and is probably one of the most enticing properties on the market

The year 1883 marks the beginning of surveys of mining locations on the Lake-of-the-Woods. No less than 4,000 claims have since been surveyed, during the last two years 2,500, and over 1,500 during the last 12 months. Within the district 1,500 patents and mining leases have been issued, covering over 2,000 claims. From fifteen to twenty Ontario land surveyors and their assistants are in the field at the present time, hard at work. Of the 4,000 claims already staked out there are, of course, an unusually large number of worthless and comparatively worthless properties, but at the same time there appear to be an unusually large number of promising veins. If one claim in every 100 proves a paying mine, forty gold mines in the district mean a great deal. If 2 per cent. prove successful properties, it will make one of the best gold regions in the Dominion, if 5 per cent. it will surpass that of California. A

* A paper read before the Association of Ontario Land Surveyors.

purchase, carefully and judiciously made, may be safely calculated upon as likely to yield, under proper and economical management, profits that will compare very favorably with some of the best known gold districts. It is not improbable that even a few very rich claims will be found, but the legitimate claims of the region are based upon the free-milling character of the ore, the large quantities of ore in sight, the true fissure veins, the economy with which the ore can be worked, owing to the abundance of fuel, the splendid shipping facilities afforded by the navigable streams and lakes, and the abundance of good water-power.

One great drawback, however, to the mining development of Western Ontario is the fact that so many of Ontario's investors are land speculators, rather than mining developers. They are willing to lease or purchase large tracts of mining land at $1 or $2 per acre, with the hope of selling it at a fabulous price, without spending one single dollar in development work, and thus the barter and sale of mining lands go on. Many of the small investors in the poorer claims will never reap a dollar in return, and there are hundreds of worthless claims in this district. I fear that in the course of only a few years, at the mouth of the shaft of many of these partly developed claims could be erected a slab, and on it the inscription written, "Died for want of sufficient capital to develop."

This new district is a province within itself with a future, possessed as it is of great natural advantages as a mining country, and peop'ed with an industrious race, her progress cannot be checked, as her resources are becoming better known, her towns and villages are becoming more populous, while sturdy farmers from the East are filling her agricultural areas, and on every hand can be seen abundant evidence of prosperity and advancement.

## THE VALEDICTORIAN AT McGILL.

G. R. MCLEOD.

G. R. McLeod, the valedictorian, said among other good things that they should be pleased that in their day a common interest actuated all the faculties, and made the success of class day and such like university undertakings a great success. One and all were coming to understand the unity of learning, a principle so ably upheld by the Principal and professors. Mr. McLeod then turned to his own faculty, that of Applied Science. During the four years the number of professors had been doubled, and the laboratories enlarged and filled with costly instruments. This was due to McGill's great benefactor, who will ever live in the memories of the Science men. With reference to the appointment of professors, Mr. McLeod continued, while not disregarding for a moment the ability of professors from other lands, yet he thought McGill graduates should be given a chance. Already those who had been appointed had filled their positions with distinction and success, and there ought to be more of them. At a time such as this there was a feeling of regret at saying farewell to University life. While a student was enriching his mind at the shrine of knowledge, he was not lessening the store, but adding to it. In this it differs from other pursuits, and in this lies its great chance. Mr. McLeod closed with a few well chosen words of farewell to the Dean and professors, speaking also of the regrets felt by all the class in breaking, for the time, at least, friendship which had sprung up during the year, and which had been of so much help in the student life.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain to Canada for March, 1896 and 1897, and the three months ending March, 1896 and 1897 :

| | Month of March, | | Three months ending March, | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery .... | £6,228 | £4,955 | £16,322 | £12,018 |
| Iron, etc.— | | | | |
| Pig iron..... | 748 | 20 | 3,781 | 455 |
| Bar, etc..... | 645 | 830 | 3,067 | 3,031 |
| Railroad ..... | 1,111 | 3,295 | 1,963 | 3,847 |
| Hoops, sheets, etc..... | 877 | 2,700 | 3,249 | 6,311 |
| Galvanized sheets ..... | 1,312 | 2,615 | 5,333 | 5,841 |
| Tin plates ..... | 8,165 | 23,141 | 31,134 | 61,542 |
| Cast, wrought, etc., iron .. | 3,642 | 2,252 | 9,566 | 7,004 |
| Old (for re-manufacture) .. | .... | 96 | .... | 572 |
| Steel ..... | 5,469 | 5,302 | 17,554 | 10,235 |
| Lead ..... | 702 | 791 | 2,870 | 2,070 |
| Tin, unwrought ..... | 1,584 | 947 | 3,671 | 5,444 |

## NEW ACETYLENE GAS LAMP.

A representative of THE CANADIAN ENGINEER has had an opportunity of inspecting a portable acetylene gas lamp, manufactured by the R. Mitchell Co., of Montreal, and invented by Dr. Casgrain, Quebec. It is now generally known that acetylene gas is produced by bringing calcium carbide in contact with water, and that this gas yields a light far more brilliant than that from coal gas and so pure that it is now used for photographic purposes. The upper part of the lamp contains a receptacle for water which is filled in the same way as an ordinary oil lamp. This is inserted into the cylinder containing the carbide, and the whole apparatus into a metal case, which may be plain or highly artistic, according to purse and taste. The water is allowed to run slowly from its receptacle on to the carbide, and the gas, which is instantly generated, begins to rise through an ordinary gas nipple. The quantity of gas generated is regulated by the stream of water and the water by a cock exactly as in a gas burner. The lamp is constructed on a plan which renders anything like explosion impossible, and produces an unmistakable warning when the gas is generated too fast. Water is easily enough obtainable and the carbide can be obtained at the rate of $80 per ton. One pound of the carbide is enough to prodnce an exceedingly brilliant light for 6 or 8 hours, at a cost of 1 cent per hour.

## MINERAL PRODUCTION OF BRITISH COLUMBIA.*

AMOUNT AND VALUE OF MATERIALS PRODUCED 1895 AND 1896.

| Customary Measures. | 1895 Quantity. | 1895 Value. | 1896 Quantity. | 1896 Value. |
|---|---|---|---|---|
| Gold, Placer....Oz. | 24,084 | $481,683 | 27,201 | $544,026 |
| " Quartz ...Oz. | 39,264 | 785,271 | 62,259 | 1,244,180 |
| Silver.....Oz. | 1,496,522 | 977,229 | 3,135.343 | 2,100,689 |
| Copper .....Lbs. | 952,840 | 47,642 | 3,818,556 | 190,926 |
| Lead .....Lbs. | 16,475.464 | 532,255 | 24,199,977 | 721,384 |
| Coal .....Tons | 939,654 | 2,818,962 | 846,235 | 2,327,145 |
| Coke .....Tons | 452 | 2,260 | 615 | 3,075 |
| Other materials..... | ..... | 10,000 | ..... | 15,000 |
| | | $5,655,302 | | $7,146,425 |

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting held on the 8th ult., Henry Irwin read a paper on the "Fraser Valley Reclamation," by R. E. Palmer, A.M., Can. Soc. C.E., the discussion upon which was postponed to next meeting. At the meeting held on the 22nd, under the presidency of P. A. Peterson, some members wished to discuss the paper read at the previous meeting on the "Fraser Valley Reclamation," but it was thought advisable to defer this until word could be received from the author. The discussion on Mr. Atkinson's paper on "A New Method for Dressing Car Wheels, Axles," etc., was then opened. A letter on the subject from Herbert Wallis was read by Secretary McLeod. He had tested wheels, both old and new, by the process referred to, and the experiments did not seem to warrant a change of methods. He expressed himself as quite in accord with the opinions of the author. Prof. Nicholson said he had seen a similar device at the Dominion Bridge Company's works, and wished to ask Mr. Atkinson how does the co-efficient of friction vary with speed? The co-efficient of friction diminishes so much at high speed that it pays to increase heat by electricity. What makes the grinding of chilled wheels harder than the chilling does? What is Mr. Atkinson's theory of what happens? Mr. Atkinson, in reply both to the letter previously read and to Prof. Nicholson, said that Mr. Wallace had taken for his experiments what are considered as condemned wheels. No wheel remains perfect long after being put into use. The cost of hauling a train is largely increased by the imperfections of wheels. Wheels could be dressed by the new process at a cost of 25 cents each. With regard to the question of abrasion, it is due to the friction of surfaces. The working disc will be more abraded at a lower speed than at a high one. He did not see how temperature could enter into the question. The particles from steel wheels are red hot. Not so with cast iron. The temperature in the latter case cannot be more than 70° to 80°, and that of steel-tired wheels is so little more that they can be handled, and, therefore, cannot be much higher than blood-heat. Heat is applied only to soften the surface of steel wheels and so reduce the horse-power required to turn them.

The President, P. A. Peterson, said that when the machine was first brought to Canada he took great interest in its working. It was at first badly put up, but its merits were even then evident.

* From the official report of the B.C. Minister of Mines.

It often happens that a day and a half is consumed in dressing a wheel by present methods, while this process would take about three quarters of an hour. At the Erith works in England, they could dress twenty wheels at day, at a cost of 5½d. each. At the close of this very interesting discussion it was announced that the American Society of Civil Engineers intended to hold a three days' convention at Quebec, beginning on June 30th, and Messrs. Hunt and Owen, members of the committee, who have recently passed through the city, intimated their intention of formally inviting the Canadian Society to join them.

## THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The tenth annual banquet of the Hamilton C.A.S.E. was held in the Commercial Hotel, April 22nd. The chairman, R. Ma kie, filled the chair in his usual happy manner. The following were visitors: Aldermen Findlay, Donald, McLeod; George Black, G.N.W. Telegraph Co.; W. H. Ballard, Inspector of Public Schools, and others The toast list was as follows: "The Queen"; chorus, "God save the Queen." "Governor-General"; the "Maple Leaf" in chorus, W. S. Hyslop singing the solo. "Dominion Parliament and Local Legislature"; song, M. Wilson; response, James McLauchlin; song, W. S. Hyslop. "Our Army and Navy"; duet, W. S. Hyslop and M. Wilson; response, Thomas Carter. "The Mayor and Corporation"; song, W. Woods; response, Ald. Findlay, Donald and McLeod. "The Executive Head"; response, A. M. Wickens, Toronto; W. Blackgrove Toronto; R. C. Pettigrew. "Our Manufacturers;" response by A. Rodgers; song, Rod-Harris "Our Sister Associations"; response by Walter Fox, Toronto, and J. Geary, Guelph "The Learned Professions"; responses by George Black, Mr. Ball and Mr. Gill; song, M. Wilson. "The Press"; response by J. H. Mattice, of the *Globe*. "The Ladies"; response by J. N. Morris; song, by W. S. Hyslop. "Host and Hostess"; response by Mr. Maxey. The committee in charge of the affair was composed of R. Mackie, chairman; J. Ironside, secretary; W. Norris, W. Stevens, J. Johnson, W. Cornish. Mr. T. Bain had charge of the music and played the accompaniments.

Association Canadienne de Secours Mutuels des Ingenieurs-Mecaniciens P. of Q. have taken possession of their new hall, 392 Lagauchetiere St., Montreal. A report of the annual meeting will be given in next issue.

## CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme for the convention which opens at Niagara Falls, June 2nd:

LIST OF PAPERS.

"The Best Method of Increasing the Day Load in Central Stations'—J. A. Kammerer, Toronto. "Submarine Cables—Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country"—D. H. Keeley, Ottawa. "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination"—Wm. Thompson, Montreal. "Water-Driven Plants"—John Murphy, Ottawa. "The Commercial Aspect of Electric Railways"—C. E. A. Carr, London, Ont. "Accumulators: Their Application to Central Station Lighting and Power"—W A. Johnson, Toronto. "Why Some Lighting Plants do not Pay"—F. C. Armstrong, Toronto. "Steam End of an Electric Plant"—A. M. Wickens, Toronto.

It is proposed to introduce at this convention a question drawer, and members are invited to forward questions to the secretary prior to May 22nd, and an effort will be made to furnish satisfactory answers at the convention.

SOCIAL FEATURES.

*Wednesday, June 2nd.*—7.00 p.m.—By special invitation of the management of the Buffalo and Niagara Falls Electric R'y Co., an excursion by special electric cars from Niagara Falls, N.Y, to Buffalo. Visit of inspection to Buffalo Railway Power House. Returning, reach Niagara Falls about 11 p.m. By courtesy of the Suspension Bridge Co., members taking part in this excursion will be permitted to cross the Suspension Bridge in both directions without charge.

*Thursday, June 3rd.*—8.00 p.m.—Annual banquet at Dufferin Cafe.

*Friday, June 4th.*—By courtesy of the undermentioned companies, the following programme has been arranged:—9.00 a.m.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park and River Railway to Queenston. 9.45 a.m.—Cross Niagara River by Niagara Navigation Company's steamer to Lewiston, N.Y. 10.00 a.m.—Leave Lewiston by special cars on the celebrated Gorge Electric Railway, reaching Niagara Falls at 10.45. 11.00 a.m.—Visit of inspection to Hydraulic Power House. 11.30 a.m.—Descend by Incline Railway and take steamer "Maid of the Mist" for a trip to the foot of the Cataract, landing on Canadian side. 1.30 p.m.—Cross Suspension Bridge. 2.00 p m.—Inspection of the Power House and Works of the Cataract Construction Co. 3.00 p m.—Visits to various Electro-Chemical Works.

## THE TARIFF.

The tariff presents many difficulties, even at a cursory glance, both as to the immediate effect of its various clauses and as to the ultimate incidence of the taxation which it imposes. The whole subject is further complicated by the preferential clause, whose effects are as uncertain as at the moment its enforcement seems problematical. Whatever may be thought of freer trade with England, and most Canadians heartily endorse it, there can be little doubt of the wisdom of Protection against the United States. The Canadian tariff has been low, that of the United States high; when United States producers suffered from over-production they sacrificed their products in Canada; when the Canadian market was glutted our manufacturers had no such resource, but were compelled to dispose of their goods in competition with each other.

The abolition of the duty on machinery to be used in mining will, if not reconsidered, be a most serious injustice to a considerable number of manufacturers, many of whom have recently embarked additional capital in this department of industry. The admission of such machinery duty free means that virtually the whole trade will be done by United States manufacturers, and the prices current in the United States will rule in Canada. If a moderate duty be imposed, the Canadian maker would be enabled to remain in business, but in order to enter our market the United States manufacturer would have to reduce his price by the amount of that duty, and the prices to Canadian consumers would be practically the same as if they were supplied from the other side of the line, while all the advantages attending the development of this industry would be ours.

## ROPE DRIVING.*

The subjoined table will be found of great value to those interested in the subject of rope transmission:

| Diam. rope inches. | SPEED OF THE ROPE IN FEET PER MINUTE. | | | | | | | | | | Smallest diam. pulleys inches. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,500 | 2,000 | 2,500 | 3,000 | 3,500 | 4,000 | 4,500 | 5,000 | 6,000 | 7,000 | |
| ¾ | 3.3 | 4.3 | 5.2 | 5.8 | 6.7 | 7.2 | 7.7 | 7.7 | 7.1 | 4.9 | 30 |
| ⅞ | 4.5 | 5.9 | 7.0 | 8.2 | 9.1 | 9.8 | 10.8 | 10.8 | 9.3 | 6.9 | 36 |
| 1. | 5.8 | 7.7 | 9.2 | 10.7 | 11.9 | 12.8 | 13.6 | 13.7 | 12.5 | 8.8 | 42 |
| 1¼ | 9.2 | 12.1 | 14.3 | 16.8 | 18.6 | 20.0 | 21.2 | 21.4 | 19.5 | 13.8 | 54 |
| 1½ | 13.1 | 17.4 | 20.7 | 23.1 | 26.8 | 28.8 | 30.6 | 30.8 | 28.2 | 19.8 | 60 |
| 1¾ | 18.0 | 23.7 | 28.2 | 32.8 | 36.4 | 39.2 | 41.5 | 41.8 | 37.4 | 27.6 | 72 |
| 2 | 23.1 | 30.8 | 36.8 | 42.8 | 47.6 | 51.2 | 54.4 | 54.8 | 50.0 | 35.2 | 84 |

## FIRES OF THE MONTH.

April 3rd.—A. Robson's elevator, Ayr, Ont. Loss, $4,500.——April 3rd.—McKinnon Sash and Hardware Co.'s factory, St. Catharines. Ont. Japan room damaged, $11,000.——April 6th.—Portland Packing Co.'s lobster factory, Canso, N.S. April 6th.—Jacques' saw mill, Hagersville, Ont.——Apr. 8.—Globe flour mills, Cornwall, Ont Loss, $20,000.——April 10th.—Saw and grist mills, Verner, Ont., belonging to Father Paradis.——April 17th—The Rathbon Co.'s shingle dock at Deseronto, Ont.——April 22nd.—G. A. Burrows' carpet factory, Guelph, Ont. Loss, $4,500. April 22nd.—Norsworthy & Lindop's machine shop, St. Thomas, Ont. Loss, $1,000.

THE "Societe de l'Industrie Minerale" of Saint-Etienne, France, invites original communications from its members on mining, metallurgy and mechanics, for which the Council will award premiums varying from five hundred to one thousand francs. The subjects to be dealt with are: in the mining section, the working of thick-coal seams, and underground haulage by compressed air or electric locomotives in the metallurgical section, the methods for removing dust from combustible gases, the manufacture of open-hearth steel, and the utilization of the waste heat of furnaces for steam boilers; and, in the mechanical section, the use of high pressure, cut-off gears, compounding and condensation in winding engines, and the employment of superheating in steam engines. The papers must be written in, or translated into French, and must be in the secretary's hands by December 31st, 1897.

* Table of the horse power of transmission rope, reprinted from the transactions of the American Society of Mechanical Engineers, vol. xii., page 230, article on "Rope Driving," by C. W. Hunt. The working strain is 800 lbs. for a 2-inch diameter rope, and is the same at all speeds, due allowance having been made for loss by centrifugal force.

## PEAT FUEL ON RAILWAYS.

*Editor* CANADIAN ENGINEER:

In your number for last month there is an article by Herbert Wallis, late mechanical superintendent of the Grand Trunk Railway, on the "Efficiency of Coal Consumption in Railway Practice," in which he makes a comparison between wood and peat as fuel for locomotives; as it stands in Mr. Wallis' paper, peat is made to appear of 50 per cent. less value than wood, a statement which is misleading and requires qualification. I am interested in peat, and have been engaged in its manipulation, more or less, for thirty years, and cannot allow that statement to go forth and remain unnoticed.

Archibald Blue, director of the Bureau of Mines of Ontario, in his report for 1891, has an exhaustive chapter on "Peat, its Use and Value for Fuel." At page 206, speaking of Mr. Wallis' report on his trial with peat, he says: "It is evident from the result of these experiments that the peat which Mr. Wallis had under trial was of inferior quality, and although it is stated to have been compressed, the fact that he objects to it on the score of its losing materially in weight, shows that it cannot have been properly dried. No one could pit green or air-dried peat against dry, hard maple or Welsh coal with the expectation that it would compare favorably with them. The tests appear to have been fairly and carefully made, but if the peat was not a representative article in point of quality, as is probable was the case, they ought not to be considered as conclusive evidence of its inferiority to the other fuels with which comparison is made."

I can speak with some confidence in corroboration of the deduction arrived at by Mr. Blue as to the quality of the peat used by Mr. Wallis in 1875, the year in which he says his observations were made. The year 1874 was a very favorable year for peat operations, and the Canada Peat Fuel Co., who supplied the peat used on the G.T.R., made a much larger quantity than usual, insomuch that their storage sheds and drying beds were completely filled. The Grand Trunk Railway Co., according to their agreement, were to remove 300 tons per day, but they failed to remove more than 60 or 70 tons per day, consequently there was no room to complete the curing of the peat during the short summer season, and a large quantity, some thousands of tons, was imperfectly cured and was partially frozen during the following winter. A curious feature of peat when condensed by maceration is that if it is allowed to freeze in a partially dry state then thawed and the drying completed, it loses density and weight and returns to its original spongy state.

The larger quantity which had been stacked or stored for the winter incompletely dried, was frozen and then dried the following summer of 1875, was of a loose spongy nature, and had lost that density and hardness which would enable it to resist the blast of a locomotive, and this was the peat used on the locomotives of which Mr. Wallis speaks. There was another reason why the peat did not compare favorably with wood: the fire grates and blast were not altered to suit the peat, but were used indiscriminately as for wood. Numerous trials on the Grand Trunk Railway with fairly good condensed air-dried peat, under careful usage, gave results of from 45 to 55 lbs. per mile.

DAVID AIKMAN.

St. Lambert, April 20th, 1897.

## SEWAGE DISPOSAL.

We have received the following letter from the International Water and Sewage Purification Co, Ltd., London, Eng, and we append a letter by the author of the article complained of, which gives his explanation of the subject.

*Editor* CANADIAN ENGINEER.

DEAR SIR,—We have had brought to our notice the March number of your valuable journal, in which there appears an article on "Sewage Disposal," by W. M. Watson, Toronto, from which it is evident that the writer of the paper has confused the porous carbon process of sewage treatment with the ferrozone and polarite process of the International Water and Sewage Purification Company. It is stated in the article that in the porous carbon process "the sewage is clarified by a precipitant named ferrozone, and then passes through a filter containing polarite. This method has been severally criticized in England. . . . it is stated that the Porous Carbon Co. was offered every facility to prove the efficiency of its system at the town of Liecester, England, but they had utterly failed to produce a telling effect." From the above extract it will be seen that it is only right that you kindly allow us space to correct the error into which the author of the article has fallen by mistaking the Porous Carbon Company for the International Water and Sewage Purification Company. The International Company are the sole proprietors of ferrozone and polarite; the Porous Carbon Company, which has now ceased to exist, used materials entirely different from those of this company.

The International system includes all the latest improvements for the efficient and economical treatment of sewage, and has been adopted at over 300 towns and places in this country, and is in most successful operation at a great number of sewage works, purifying all kinds of sewages. Her Majesty's Government have had it in use for the past six years with entire satisfaction, and its adoption is being extended to all parts of the world. We would like to say that at Liecester the International system was demonstrated with complete success after the Carbon Company's process had failed, and the following is an extract from the report of the medical officer of health of that town:

"*Re Polarite Filter.*—We have had constructed at our sewage works an experimental filter of the above material, which has undoubtedly yielded better results than any of the numerous processes adopted here. It gave a filtrate which remained free from putrescence or appreciable smell after being kept continuously at a temperature of over 70° Fahr. for three weeks." The report further adds that the filtered effluent remained free from smell or unpleasant odor, even when exposed for three weeks hot weather in a large tank to the sun and air. Fish also lived in it, a striking proof of the comparative purity of the water.

When we mention that such towns as Middleton, Nelson, Wednesbury, Royton near Oldham, Maidenhead, Bowness on Windermere, Failsworth, Blackburn, Darwen, Chorley, Crompton, Melton Mowbray, etc., etc., as well as the Home Office and War Office Departments of H. M. Government have adopted the ferrozone and polarite process, and that it has been favorably reported on by some of the most eminent scientists and sanitarians of the day. We trust we have made it clear to your readers that, instead of being a failure, the International system is a highly successful, and the most economical method of treating a town's sewage, as is proved by its very extensive use.

The Engineer in Chief to the Local Government Board of England, Major H. Tulloch, R.E.C.B., has inspected the International process in operation at several sewage works, and the following is a copy of the opinion he expressed:

"The results are most excellent. The sewage was very strong, but the effluent from the polarite filters was most beautifully clear, and without any smell or taste."

We are, yours obediently,

THE INTERNATIONAL WATER & SEWAGE PURIFICATION CO., LTD.

*Editor* CANADIAN ENGINEER:

DEAR SIR,—Replying to the letter from the International Sewage Purification Company, dated March 27th, I may say that I am not confused, for I believe I rightly understand the International Company to be a new name for the Porous Carbon Company, which they very properly say ceased to exist when they registered themselves as the International Water and Sewage Purification Co., and that what ever kind of percipitant they thought it necessary to use for clarifying sewage they alone should be allowed to call the chemical ferrozone and the material used for filtering, polarite. This statement may be proved by referring to their own advertising pamphlet, page 5, where they say that the polarite filter beds at Acton sewage disposal works are now (1894) working as well and effectively after continuous use since 1887 (a date previous to the registration of the new name) as when they were laid down. Then turn to the report on the Treatment of Sewage made by Arthur Turley, Esq., C.E, of Leeds, England, dated 1890. On page 11 he reports that the porous carbon process has been working at Acton for some time and that the precipitant used is magnetic ferrous carbon—probably some of the same chemical that they now call ferrozone. He also reports that the cost of constructing the works was £400, and annual cost of management was £133 6s 8d. for each 1,000 of the population.

I have a copy of a report from Acton Local Board in 1892, stating that their sewage system was satisfactory, but that they would prefer irrigation. They do not contradict my quotation from the records of the civil engineers, but state that their system was demonstrated with complete success at Leicester. Now I have a copy of a letter before me written by the Leicester corporation, dated 1892, stating that they have lately disposed of their sewage principally by broad irrigation over a space of 1,400 acres of land, and that a portion of their old works was still treating sewage by undergoing a chemical treatment, by mixing six grains of the ferrozone and eight grains of lime to each gallon of sewage, but that

they intended to abolish the chemical system altogether when the land was all in working order.

If the International system, after years of trial, was such a grand success, why had not the Leicester corporation adopted the scheme in its entirety. The International Company, on page three of their pamphlet, speak strongly against using lime as a precipitant; but the Leicester people use eight grains of lime to six of ferrozone, and by this time will have given up using ferrozone altogether.

One reason why some surveyors and engineers, in England, criticize the International Co.'s sewage system, is because of the high cost of management and plant. Then it is generally understood, in fact the letter they have written for your publication shows, that they use the American methods of securing orders, and cracking up their business. To further prove this statement, I have a communication from Messrs. Duncan & Pickard, engineers, 89 Albion street., Leeds, England, informing me that in November, 1893, the International Company issued a circular, stating on the authority of W. Naylor, the Sewage Inspector to the Ribbe joint committee, that the Carbonizer Refuse Filter System of cleaning sewage only effected the removal of one per cent. of the organic matter, albuminoid ammonia, and that when they wrote to Mr. Naylor calling his attention to the erroneous statement, Mr. Naylor tested the effluent from the same works of the rival company, viz., the Carbonized Refuse System of sewage purification promoted by their clients, and found that there was removed from the sewage by that process over 62½ per cent. of albuminoid ammonia. This statement needs no comment. With reference to expert testimony, I will ask your readers to again look at the third paragraph of my article, page 326 of your March number. There is abundant proof that if a firm be rich enough they can secure plenty of favorable expert evidences. It may at present also be sufficient to show one proof.

On page 117, in the *Surveyor*, dated January 29th, 1887, printed in London, England, your readers can find that Dr. Riddle states that forty-five per cent. of albuminoid ammonia is removed by the new process lately introduced of cleaning sewage by allowing it to stand for a time in a dark tank. This is called the Septic System. Another noted expert named Dr. Voelcker, states that the effluent from the septic tanks is worse than the inflowing sewage, and that nothing whatever is removed by this process. Query--which of the two experts is speaking the truth?

I could give a large amount of information which I have received from England and Ireland referring to the International Purification Co., but it will be unfair to trespass on your space, and will conclude by drawing your attention to the fact that in none of the three articles on the subject which you so kindly put in your paper have I in any way mentioned the International Company's name; had I done so it would have acted as a free advertisement. Therefore I cannot see any cause for complaint against the paragraph mentioned.

W. M. Watson,
Dundas street, Toronto.

## LITERARY NOTES

The published Charter, By-Laws and List of Members of the Canadian Society of Civil Engineers for 1897, forms a little book worthy of the importance of that society. The society was established in 1887, and incorporated by Dominion Act in the same year. The statement of membership for the present stands as follows:

| | |
|---|---|
| Honorary members | 8 |
| Members | 271 |
| Associate members | 145 |
| Associates | 42 |
| Students | 121 |
| Total | 587 |

The officers of the society consist of a president, three vice-presidents, a treasurer, secretary, librarian, the past presidents, styled honorary councillors, and 15 councillors. The objects of the society are to facilitate the acquirement and interchange of professional knowledge among its members, and to encourage original investigation. In addition to this, there is evident a great desire to inspire a proper sense of the responsibility, and the code of ethics is admirably adapted to that purpose. It enjoins on every member the duty to perform the work he undertakes to the best of his ability, and in the true spirit of his engagement, feeling it his duty to present all ascertained facts in their true light. He must also loyally obey and support his chief. His reports must be full and explicit on all important points, and exact to the best of his knowledge, cloaking nothing, even though likely to show that previous reports have been inaccurate. He is also to avoid connecting himself with schemes of a merely speculative character, bearing in mind that his professional reputation will be judged largely by the inherent merits of the undertakings with which his name may be connected. The meetings of the society are now being well attended, the papers read before it are of a highly instructive and scholarly character, the library is growing beyond its allotted space, and since there is a respectable building fund, the society may ere long be housed in handsome premises, with provision for the growth which may be predicted for so earnest and important an organization.

A first prize of $500 and a number of smaller prizes have been offered by The Century Co., publishers of The Century Dictionary and Cyclopedia, for the best answers to a hundred and fifty questions covering a broad range of information. A sample question, which is easier than some of them, is as follows: "What is the approximate difference in altitude between the loftiest Alpine summit and the bed of the greatest depression in the Mediterranean basin?" An additional prize of $500 is offered to any one who can answer 90 per cent. of the questions from any ten published works of reference other than The Century Dictionary and Cyclopedia.

We have just received the 1897 edition of the *Indian and Eastern Engineer* Diary, which is issued gratis to subscribers from 137 Canning St, Calcutta, and 28 Victoria St., London, S.W. It is a substantial quarto volume containing all the internal evidence of a successful publication, interleaved and substantially bound. The information it contains is that which is most frequently required by engineers and the various trades allied to engineering. It includes the Christian, Bengalee, Fuslee and Mohammedan calendars; Indian railway, hotel, bank and club directory; the customs tariffs of Ceylon, China, Corea, England, Japan and Netherland India; English and metric weights and measures: Indian steamship lines; postal information; patent stamp fees and a wealth of technical data for professions and trades.

Walter G. Berg, of the engineering staff of the Lehigh Valley Railway, made an interesting speech before the New York Railroad Club during the discussion on G. B. Leighton's paper on "The Profession of the Railway and a suggested Course of Training therefor."

The Colliery Engineer Co., Scranton, Pa, proprietors of The International Correspondence Schools, announce that commencing with the February issue the name of the journal, *Home Study*, which they publish, will be changed to *Home Study Magazine;* the page will be reduced to magazine size, but the number of pages will be doubled.

# Mining Matters.

The gasoline engine is now operating the hoist at the R. E. Lee mine at Sandon, B.C.

The Anglo-Canadian Asbestos Co. has commenced to work its chrome pits at Black Lake.

The Thetford, Que., asbestos mines are said to possess the largest deposit of that mineral yet discovered.

The discovery of a bed of sand which assays nearly $500 per ton in gold, is reported from the Parry Sound district.

A. Dick, M.E, has recently inspected and surveyed the Rawdon gold areas owned by C. H. Dimock, Windsor, N.S.

Dr. W. T. Stuart, Toronto, is interesting himself in the introduction of the Beams process of reducing the refractory ores of Hastings county, Ont.

Considerable excitement was caused at Selkirk, Man., over some splendid samples of asbestos that were brought in from Lake Winnipeg by gold prospectors.

The lithographic stone from W. H. Casement's quarries, near Lakefield, Ont., is said to be of a good quality, and recent tests pronounce it almost equal to European.

Preparations are being made for the construction of a 50-stamp reduction mill at the Dick and Bannim Water Power, Keewatin, and work will be commenced at once.

The Joggins mine is now producing daily about 320 tons of coal, mined in such a way as to give perfect satisfaction to all consumers. Manager Archibald is putting in new boilers.—*Amherst News.*

THE Ottawa Gold Milling and Mining Co. propose to erect a large stamp mill at Keewatin. The promoters, among whom are John Mather and A. W. Fraser, of Ottawa, propose to expend $100,000.

THE township of Madoc, Hastings, derives an income from a hematite iron mine situated under the county road on lot 12 in 5th and 6th concessions. The mine was recently disposed of to A. F. Wood for a royalty of 60 cents per ton.

SELKIRK, Manitoba, reports say M. O'Donohoe and R. Smith returned home from the north a few days ago from a prospecting trip, and brought specimens of anthracite coal from the west shore of Lake Winnipeg, about 160 miles from Selkirk.

THE Broughton Mine, Danville, Que., owned by the Glasgow and Montreal Asbestos Co., was leased and worked the past season by the United Asbestos Co., and some of the best asbestos in the world was taken out, having a length of from six to seven inches.

TORONTO Tudor Gold Mining Co. has sold the Craig mine, near Bannockburn, to a company represented by J. D. Edgar, Oronhyatekha, M.D., and others, for $47,000. This is a mine that was purchased a few weeks ago from Peter Vankleek, James Maitland and others for $12,000.

IT appears to be beyond reasonable doubt that the silicious ores of Rossland are free milling and that at least 75 per cent. of the values can be saved on the plates and in the concentrates. Captain Hall, superintendent of Le Roi mine, has recommended the construction by his company of a 200-ton milling plant.

THE Canada Copper Co. is operating its Sudbury mines at a profit of ten per cent. The Cliff, Evans and Slater are the names of the three nickel mines now being worked by the company. On the cliff the shaft is down 700 feet, and in this mine there is said to be enough ore in sight to maintain the present output of ore—viz., 400 tons daily—for 60 years to come.

WHEN the people in the east recover from the circular insanity that caused them to buy so much wild cat stock last year, they will be wild with rage. As in the matter of prize fights, their own press is more to blame than the sharks from Spokane and other American cities who have worked their graft so successfully upon the fools of eastern Canada.—*New Denver Ledge.*

THE issue of shares at the price of a single dollar has been a good deal talked about, but a company has been formed in Dublin with shares of a par value of one penny. A director must own one thousand shares, the vale of which is a little over $20. The object of the company—which is called the Jehol Mining Co.—is to carry on mining operations "in Asia or elsewhere."—*Ex.*

THE Delaware and Mount Brydges Oil and Gas Company, Ltd., purposes to explore for petroleum. It has a capital stock of $10,000 in shares of $5 each, and is composed of Henry Johnston, Frank Haycroft, John McEwen and John Ackland Miller, of the township of Delaware, and Thomas Pearce, Geo. Bignall and John Howe, of the township of Caradoc, county of Middlesex, Ont.

THE Calgary *Tribune* says: A big gold-saving machine, occupying two freight cars, has arrived in Calgary from the east. It was billed as a "smelter," and is intended for extracting gold from the richly mineralized sands of the Saskatchewan River. It has been found that the old-fashioned method of gold-washing with grizzlies saved only 20 per cent. of the gold, and this accounts for gold continuing to be found in sand which has been worked over and over again. The present machine has been imported from Omaha, Nebraska. The owners took some of the black sand to their own smelter at Omaha, and found that it assayed as high as $268 to $280 to the ton.

DR. R. W. ELLIS was engaged during the past summer in the counties of Renfrew, Addington, Frontenac, Lanark and Carleton in Ontario. North of the Mississippi River, from Ardreh to Long Lake, there is an area in which silver-lead ore in paying percentages is to be seen. Gold is also found there, and although the appearances indicate pockety quartz, it is thought probable that fissure veins will some day be discovered, as there is every probability of the area of rock being identical with that found in Madoc and Marmora. This formation has in fact been pretty well traced and is found to end at the juncture of the Bonnecher and with the Ottawa River. Having its northern apex lying between this point and the town of Renfrew, the band has been traced in a generally southeasterly direction through the Country of Lanark into Leeds a few miles, Frontenac, Addington and Hastings; the main direction of good prospecting country being through the townships of Marmora, Madoc, Elzevir, Kaladar, Anglesea, Barrie, Clarendon, Palmerston, Lavant, Darling, Pakenham and McNab.

REPORTS from White River, some 300 miles east of Port Arthur, are very encouraging in their nature. Gold has been discovered in more than one instance, and it is also said that splendid samples of iron ore, going 62 per cent. metallic iron, have been brought in. If this thing keeps on every C.P.R. station along the line from Sudbury to Rat Portage will be turned into a mining camp. The list of stations and towns now recognized as mining or semi-mining camps includes White River, Jackfish, Schreiber, Nepigon, Ouimet, Port Arthur, Fort William, Finmark, Savanne, Bonheur, Ignace, Wabigoon, Rat Portage.—*Toronto World.*

THE statistics of the mineral production of the United States, which appeared in our last issue, were reprinted from *The Engineering and Mining Journal*, New York, which publishes the mineral statistics about a year before the government, and which are much more accurate and complete than those collected by the United States Geological Survey, a fact so well known that the British Government has adopted these statistics exclusively in its blue books, and the French Government also uses them. It was quite an achievement to be able to publish January 1st, the statistics of mineral production for the whole United States up to the 31st December, 1896, as the *Engineering and Mining Journal* did.

J. B TYRRELL, of the Dominion Geological Department, says of the country north of Lake Winnipeg that "around Herb Lake large masses of eruptive grey and red granite were found, through which run many quartz veins, associated with a good deal of iron pyrites. On Reed Lake, near by, the green slaty rock is cut by many stringers of quartz. The same is true about Cranberry Lake, also near by. "This area of Huronian rocks," says Mr. Tyrrell, "extending about 75 miles from east to west, and an unknown distance toward the north, presents a good field of exploration for the prospector for gold and other precious metals, on account of the number and variety of eruptive masses that break through it, surrounded by zones of highly disturbed and fissured rocks."

A LETTER has been received from William Ogilvie, the Dominion Land Surveyor, dated January 11th, 1897, and has just come to hand. He says that Thos. M. O'Brien, a merchant of Forty Mile, intends going to Ottawa, and he took the chance of sending an interim report along with him. He reports that the prospects of the Clondyke are still very encouraging. "So much so in this case," he says, "that all the other creeks are practically abandoned. Especially is this so in regard to Forty Mile, in American territory, and nearly one hundred men have made their way from Circle City. Those who cannot get claims are buying in on those already located. Men cannot get anyone to work for love or money, so scarce are laborers, and development is consequently very slow. One dollar and a-half per hour are the wages paid. A few men work for higher wages, and they are permitted to remain on duty as many hours as they please. Some of the claims are so rich that over night a few pans of dirt suffice to pay the hired labor. As much as $204 has been reported in a single pan."

IN the anuual reports of the School of Mining, Kingston, Ont., Prof. Goodwin, director, reports a great advance made; 502 students have attended classes in the science hall, and the graduates had all obtained positions in mining work. Thirty had taken the winter prospector's course of eight weeks, and these embraced civil engineers, surveyors, experts and graduates of other science schools. Over 300 had attended the ten outside classes in as many parts of Ontario last summer and fall, under Profs. Merritt and Miller. Instructors Pope and Brock were about to leave, the former to study in Germany under a valuable scholarship, and the latter to join the Government geological survey. Prof. Nicol would return from Germany in August to resume his work. The elections for the ensuing year of the Board of Governors resulted as follows: E. W. Rathbun, Deseronto; James Haydon, Camden; A. Barnet, Renfrew; Hon. Wm. Harty, James Swift, E. J. B. Pense, John McKelvey, G. M. Macdonnell, Robert Crawford, G. Y. Chown, W. B. Carruthers, William Mickle, Kingston. Alds. Livingston and Donnelly represent Kingston city council and Warden Taggart represents the county council.

AT the meeting of the Federated Canadian Mining Institute during the discussion on the C. F. Andrews' paper, "Notes on the Mining of Low Grade Ores in Nova Scotia," J. F. Lewis, of the Rand Drill Co., said: "This paper is very interesting to all of us, especially to those interested in Nova Scotia, for the reason that it proves conclusively that the low grade ores, which are so abundant—not only in Nova Scotia but in British Columbia—can be mined and milled cheaply enough to make such mines pay the investors. It is no doubt very creditable to the management that they are mining this rock at $1.65 per ton, but I wish to suggest that without question it can be mined even cheaper than that, by putting in

proper machinery for breaking the rock. I would cite as an instance the Atlantic Copper Mine in Lake Superior—the rock carrying only .64 of 1 per cent. copper. They are raising this ore 3,000 feet; hauling it four miles by railway train; putting it through the stamp mill for $1.12 per ton, and they expect to get the cost of it down this year to $1 per ton, therefore I think this paper should be a great encouragement to those interested in low grade ores, and also an incentive for every mine manager to produce his ore cheaply."

FROM a report which has been issued by the Geological Department it appears that the future of the natural gas industry, in the opinion of the mining expert, is very doubtful. It is pointed out that the rock pressure in the wells in Essex county shows no marked decrease, but this is attributed to the recent date at which the consumption became other than of a local character. There have been twenty-six wells drilled, of which sixteen are still active producers. The rock pressure is given at 400 pounds to the square inch, and the estimated output is 35,000,000,000 cubic feet per annum. A very different condition of things is reported to exist in the Welland gas fields, from which Buffalo draws its supply. As to that district the report continues: According to the opinion expressed by several of the leading authorities on the subject, it would appear to be merely a question of a few years before the gas supply in the Welland field will be exhausted, at least for commercial purposes, though a small flow may still continue for a much longer period, which will be of service for domestic uses to farmers and others with wells on their premises and requiring only a very limited daily supply. In support of this opinion, mention may be made of the Provincial Company's well No. 63, drilled in 1893, which yielded when the gas was struck a flow of 10,000,000 cubic feet per day. The flow from this well has now decreased to such an extent that it does not produce 400,000 cubic feet in the same time, although it has in the interval been several times fed from the other wells.

# Marine News.

CAPT. BOURMAN has charge this season of the ferry steamer "Janet Craig," Arnprior, Ont.

THE Rathbun Co., Deseronto, Ont., will, it is said, put a boat on the Brockville-Gananoque route.

OSCAR DAKIN, Digby, N.S., the first officer of the Government steamer "Newfield," has been relieved of duty.

AN influential deputation waited on the Dominion Government urging the claims of the Rideau canal to improvement.

W. H. EMBREE & SON, Port Hawkesbury, Cape Breton, recently supplied a steam yacht to J. Robinson, Newcastle, N.B.

THE B.C. Iron Works, Ltd., Vancouver, B.C., is now placing in position the engines in the new C.P.R. steamer at Rosebery, B.C.

THE Pembroke Navigation Company is asking for incorporation. The capital stock is $40,000, and Hon. Peter White is one of the directors.

CAPTAIN W. O. ZEALAND commands the McKay steamer, "Michigan," which was rebuilt at Port Dalhousie. Jas. Belanger is chief engineer.

THE Hamilton Steamboat Co.'s str. "Macassa's" officers this season are: A. Crawford, captain; L. Walsh, first officer; Purser Arthurs and Engineer Durham.

SUPT. ELLIS, of the Welland Canal, has been superannuated, and W. G. Thompson, superintending engineer, will combine his duties with that of superintendent.

DAVIDGE & Co., of Victoria, B.C., are asking a yearly bonus of $100,000 for four years to establish a monthly service between Victoria and Central America and Mexico.

THE contract for dredging Collingwood, Ont., harbor has been awarded to Boon, Armstrong & Company. One of the most powerful dredges in the lakes will be employed.

HON. A. G. BLAIR, Minister of Railways and Canals, has made the announcement that all the St. Lawrence canals will be enlarged to a depth of fourteen feet by the spring of 1899.

THE Wahnapitae Navigation & Transportation Co., Ltd., applies for an Ontario charter; chief place of business, Sudbury, Ont.; capital, $50,000. The incorporators are A. Gordon, F. Cochrane, D. O'Connor, F. Hamilton, Sudbury, Ont., and I. Eastwood, Wahnapitae, Ont.

CAPT. J. S. MOORE will be in command of the "Leonard Tilley," of the McKay line, and James H. Brown will be first engineer. Richard Freeman will be captain on the "T. R. Merrit"

THE Pembroke Navigation Company has given orders to the Polson Iron Works, Toronto, for a new steel steamer, to ply on the Ottawa River between Pembroke and Des Joachims, to be ready about July 1st.

DURING a gale on the St. Lawrence, April 26th, the steamer "Rosedale," of the St. Lawrence and Chicago Steam Navigation Company, loaded with grain, ran aground and damaged her hull. She is docked at Kingston.

THE following have been appointed officers on the Dominion Government cruiser "Petrel": Capt. Ed. Dunn; first mate, A. J. Frame; second mate, F. Arnold Jarvis; chief engineer, A. J. Brown; second engineer, W. H. Linter

THE first vessel to lock through the Welland Canal this season was the Canadian schooner "Wawanosh," for Toledo. She was followed by the steamers "Rosedale," "Algonquin," "Niagara," "Bannockburn," and "Erin."

THE officers appointed to vessels by the Merchants Line, G. E. Jacques & Co., Montreal, Can., are as follows: Steamers "Cuba," Capt H. Chestnut, Engineer, E. L. Foley; "Melbourne," Capt. R. Chestnut, Engineer, Thos. Milne.

The *Algoma Pioneer* says: It is now proposed to establish a line of boats to Manitoulin Island, with headquarters at the Sault, and make this the depot for the valuable products of the islands and north shore, instead of carrying them to Collingwood, etc.

THE "Massena," a steamer plying between Brockville, Ont., and Ogdensburg, during the storm on April 19th, was run into Maitland, but while tied up at the wharf her upper works were knocked in by the storm, and she sank. She was loaded with oats, lumber and cement.

DUNBAR & SULLIVAN, Welland, Ont., have recently launched a scow for use on the Lachine Canal, capable of carrying 600 cubic yards of earth, It is one hundred and twenty-five feet, by twenty-eight feet beam and eleven feet sides, built in six pockets. Each pocket is lined with steel and has two steel doors, weighing 4,200 pounds each.

CAPTAIN DELANEY, of the str. "Grand Lake," has, it is said, been asked to take charge of R. G. Reid's new fast steamer to run from Sydney to Newfoundland to connect with the western terminus of the Newfoundland railway, which is being hurried forward on the Clyde. It will be about 1,200 tons in size, and capable of steaming 16 knots.

THE officers appointed to vessels by A. W. Hepburn, Picton, Ont., are as follows: Steamers—"Alexandria," Capt. B. Smith, Engineer Chas. McWilliam; "Empress of India," Capt. Geo. O'Brien, Engineer M. Tetro; "Aberdeen," Capt. M. Heffernan, Engineer George Gown; "Water Lily" to be appointed. Schooner—"Onteora," Capt. Homer Perron.

THE Collins' Bay, Ont., Rafting & Forwarding Company, Ltd., has placed the following captains and chief engineers in charge of their steamers and vessels: Str. "Orion," Capt. Alexander Milligan, Engineer Wm. Spencer; str. "Saturn," Capt. Alexander Anderson, Engineer Wm. Kennedy; str. "Rival," Capt. John A. McDonald, Engineer Z. Hamlin; str. "Petrel," Capt. McDonald, Engineer Joseph Branch; barge "Muskoka," Capt. Patrick Gallagher; barge "Waubaushene," Capt. Henry Milligan; schr. "S. Neelon," Capt. Charles Beaupre.

THE wreck of the Beaver Line chartered steamer "Assaye," on the Blonde Rock, off the Seal Islands, on the Nova Scotia coast, took place on April 5th. The steamer was coming from Liverpool to St. John, N.B., with a general cargo and passengers, the whole ship's company numbering 65. She is a steel screw, four-masted steamer with a gross tonnage of 5,129 tons, and a net tonnage of 3,981 tons, and classed 100 A 1 at Lloyds. Seal Island lies at the western point of the triangle formed by Pubnico Harbor light, Bon Portage light and its own light, being almost midway between Cape Sable and Tusket light, but off from the coast.

MORAN BROS., Seattle, Wash., propose to build steamers at Seattle, take them to the head of Lynn Canal in Alaska in sections, pack them over the mountains to Lake Bennett, in British territory, a distance from the head of Lynn Canal of about thirty-one miles, and there assemble the vessels and navigate the chain of lakes and rivers to and down the Yukon River to the gold fields. This, it is claimed, will offer a very practicable route to the new gold fields, and the trip can be accomplished in about two weeks from Seattle, whereas it now requires about two months or longer to reach the same destination by way of the mouth of the Yukon.

OTTAWA RIVER NAVIGATION Co. has appointed the following officers for its fleet for the season: Str. "Empress," Capt. A. Boure, Engineer Geo. Menish, 2nd Engineer Geo. Hodgson; str. "Sovereign," Captain H. W. Shepherd, Engineer J. F. Marchand, 2nd Engineer Thos. Therault; str. "Duchess of York," Capt. J. McGowan, Engineer A. Menish; str. "Princess," Capt. P. McGowan, Engineer F. Piche; str. "Maude," Capt. E. Gauthier, Engineer N. Fugere.

MANAGER FOY, of the Niagara Navigation Company, has appointed R. Clapp first officer of the "Chicora," to the captaincy of that vessel, in place of the late Capt. Harbottle, deceased. Captain Clapp has been with the Niagara Company since 1893, occupying the position of chief officer. Previous to that he was first officer on the "Empress of India" under Captain Solhmes, now of the "Corona." The new captain has selected as his first officer, C. Smith, who last year was second officer of the "Chippewa." W. Palen will again act as second officer, and H. Parker, engineer.

IT is very gratifying to Canadians generally to note the remarkable developments of the winter traffic at the port of St. John, N.B., and the evidence that a Canadian harbor can compete with the United States ports. While there has been a development of about 50 per cent. in the traffic during the present season over that of the preceding winter, the local manager of the Canadian Pacific Railway states that the business has only been limited by the amount of ocean tonnage offering; also that if the steamers had been available, the business would have doubled that of the present season.

THE following are the officers of the fleet which wintered at Deseronto, Ont., for this season: "Resolute," Capt. John Gowan, N. Palmateer, Mate, J. Harrison, 1st Engineer, S. Larue, 2nd Engineer; "Reliance," Capt. Jas. Daugherty, Mate, B. Barnhart, Engineers, John Toppins and A. McKain; "Ella Ross," Capt. D B. Christie, Mate, P. Farrington, Engineer, John McFaul, Purser George McGaughey; "Deseronto," Capt. Wm. Skillen, Mate, G. Arthurs, Engineer, J. Rice; "Rescue," Capt. John Rowe, Engineer, M. McFaul; "Nile," Capt. W. Daly, Engineer, Jas. Quigley; "Armenia," Capt. S. Anderson, Engineer, Rice; "Ranger," Capt. M. Woodcock, Engineer, McKain; "Norah," Capt. D. McVicker, Engineer, Toppins.

THE Richelieu and Ontario Navigation Co. has made the following appointments of officers for the fleet for the season. The list is complete as far as appointments have been made:—Steamer, "Algerian," captain, A. Dunlop; mate, Dan. Mills; 1st engineer, T. Wadsworth; 2nd engineer, G. Bourk; purser, — Dubois. Steamer "Berthier," captain, Chas. Gouin; 1st engineer, — Arcand; purser, G. Paulet. Steamer "Canada," captain, Thos. Dougall; mate, E. Duguay; 1st engineer, Ed. Dennis; 2nd engineer, — Matte; purser, F. Wurtele. Steamer "Chambly," captain, — Tranchemontagne; mate, — Robillard; 1st engineer, Chas. Gendron. Steamer "Corsican," captain, — Esford; mate, — Bushell; 1st engineer, Wm. Parker; 2nd engineer, — Guibault; purser, — Boyle. Steamer "Hamilton," captain, — Baker; mate, — Graves; 1st engineer, Wm. Black; 2nd engineer, Alex. D'Martigny. Steamer "La Cultivateur," captain, — Raymond; 1st engineer, — Noel. Steamer "Montreal," captain, L. St. Louis: mate, P. Kane; 1st engineer, H. Hamlin; 2nd engineer, E. Beaudoin; purser, J. O. Prevost. Steamer "Passport," captain, J. McGrath; mate, — Corrigan; 1st engineer, Alex. Milne; 2nd engineer, A. McBride. Steamer "Quebec," captain, L. O. Bouchier; mate, — Rocher; 1st engineer, Frs. Gendron; purser, L. Gorman. Steamer "Saguenay," captain, Geo. Riviere; mate, — Fortin; 1st engineer, — Lacroix; purser, J. Lapierre. Steamer "Spartan," captain, — Grange; mate, I. Carway; 1st engineer, Ned. Taylor; 2nd engineer, T. Noble; purser, — Tandy. Steamer "Terrebonne," captain, — Laforce; mate, — Laviolette; 1st engineer, Geo. Gendron; purser, — Masse. Steamer "Three Rivers," captain, F. St. Louis; mate, F. Ladibouche; 1st engineer, Johnny Matt; 2nd engineer, P. Papineau. Steamer "Fire Fly," captain, — Crepau; 1st engineer, P. Bouchey. Steamer "Longueuil," captain, — Jodoin; mate, — Laurin; 1st engineer, M. Beadett; purser, F. Brossard. Steamer "Sorel," captain, — Berthiaume; 1st engineer, — Beaucage. Steamer "Hochelaga," captain, — Mandeville; mate, — Poulett; 1st engineer, C. Chapdeline. Steamer "Laprairie," captain, — Coursel; mate, — McClean; 1st engineer, — Beaudoin; purser, Geo. Brossard. Steamer "Island Queen," captain, — Moneau; 1st engineer, Jos. Matt; purser, M. Gill. Steamer "River du Loup," captain, — Faubert; 1st engineer, — Gouin.

# Electric Flashes.

IT is proposed to develop power at the Nigger Rapids, Magog, Que.

THE $5,000 bonus voted by Perth to the proposed Perth-Lanark road has lapsed.

WORK was begun on the Slocan City—New Denver, B. C.—telephone early last month.

AN electric line is projected to connect St. Catharines and the H., G. & B. at Beamsville, Ont.

THE Rat Portage Electric Light Co. has its new generators for arc lighting and power running.

WORK on the Quebec Street Ry. is now being pushed, and the road is expected to be in part operated by June 22nd.

S. DOUGLAS, Stanley, N.B., is putting in an electric lighting plant which will light the village as well as his own premises.

JOHN GRAHAM, Toronto, recently recovered $300 damages from the Street Railway for being pushed off the cars by an employee,

THE Portage la Prairie power scheme was killed by the refusal of the legislature to allow the town's issuing the bonds necessary to carry it out.

THE citizens' committee of Fort William, Ont., has reported to the council in favor of an electric lighting and water supply plant to cost $42,000.

THE effects of the Holmes Electric Protection Co., Montreal, were sold by the liquidator at public auction, and were purchased by Alexander Foster for $3,400.

G. C. HUEBNER, Detroit, and J. N. Vandegrift, Philadelphia, have, it is said, decided not to build an electric road from London to Port Stanley, as it would not pay.

THE Montreal Belt Line, the electric railway which runs from Maisonneuve to Longue Pointe, Point aux Trembles and Bout d'l'Isle, has secured the mail contract between these places.

IN Davis vs. Ottawa Electric Ry. Co., the Divisional Court has justified the company's employees in ejecting a passenger who violated the company's rules by sitting with his feet on another seat.

THE Lachine Hydraulic and Land Co. has made a contract with the Standard Light and Power Co., Montreal, for the delivery of 1,000 electrical horse-power which the latter will deliver to its customers.

THE ratepayers of Dartmouth, N.S., are asked to provide the following sums: $5,000 for improved sidewalks and water and sewerage extensions; $1,500 for repairs to the steam fire engine, and $50,000 for purchasing the plant of the electric light company.

THE Windsor Electric Railway Co. is said to be anxious to secure the charter of the proposed line from Sandwich to Amherstburg, Ont., because it has already got a charter from Amherstburg to run a track along the lake front to Kingsville and Harrow and to other points.

THE Hamilton council will not grant the Cataract Power Co. permission to erect poles and string wires till more definite information is furnished as to the company's plans. It is said that the company intends to draw its supply, not from the Decew's Falls, but the old Welland Canal.

AT the annual meeting of the shareholders of the Hamilton Radial Electric Railway Company, the following board of directors was elected: A. Turner, president; T. E. Leather, vice-president and managing director; S. E. Malloch, secretary; John Moodie, James Dixon, T. H. Watson and Geo. S. Lynch-Staunton.

WATERLOO, ONT., citizens are about to adopt incandescent lighting for their places of business and residences. Two companies in the field to supply the lighting. The Gas Company, with an incandescent system, and a newly formed association called the Waterloo Electric Light Co., Wm. Snider & Co., millers, will furnish the latter electric power.

A. J. CORRIVEAU, who was the chief promoter of the system of electric railways which now covers the Island of Montreal, is interested in a scheme to build an electric railway from St. Lambert or Longueuil, opposite Montreal, to points in eastern Quebec not touched by the trunk line railway, as far as Sherbrooke, with crossing powers over the bridges, ultimately connecting with the railway systems at Newport, Vt. The company also propose to put electric launches on the River Richelieu, to run from St. John's to points

on Lake Champlain. The whole system will cover something like 150 miles, and the power is to be supplied by the Chambly Rapids Water & Power Company.

A TORONTO syndicate, which has been securing options on the stock of the Street Railway Company and other lines, of Hamilton, Ont., has laid before the city council a proposition looking to the control of the electric railways in that city. It is proposed that a company, to be known as the Hamilton Franchise Company, shall be formed to acquire from the syndicate the property upon which it has options, including the Hamilton and Dundas Railway. The syndicate will accept its pay half in stock of the company and half in bonds. The interest on these bonds is to be first charged on revenue of the company; then at 6 per cent. dividend on stock, after which the city is to receive all the balance of the net revenue up to $20,000, when the stockholders may receive another 1 per cent., and the city all the remainder. The city is to relinquish its mileage and percentage on the Street Railway earnings, which now amount to about $14,000 annually. The city will have the right to appoint certain directors in the new company. It is probable considerable discussion will take place before the deal goes through.

W. A. JOHNSON ELECTRIC COMPANY, 34 York street, Toronto, report the following sales made during the last 60 days, and not previously reported: Thomas B. Angus, Kingston, Ont, one 3 h.p. motor; Theo. Frederick, Ottawa, Ont., one 1 h.p. motor; Antelope Bicycle Works, Toronto, 12 h.p. motor; Nasmith & Co., Toronto, 4 h.p. motor; D. Hibner & Co., Berlin, 150 lt. incandescent plant; W. J. Miller, saw mill, Thessalon, Ont., 30 lt. incandescent plant; Grip Engraving Co, Toronto, four 8 h.p. motors; Murray Printing Co., Toronto, four 3 h.p. motors; Luxfer Prism Co., Toronto, our 600 ampere dynamo for depositing copper; Luxfer Prism Co., Toronto, one 4 h.p. and one 6 h.p. motor; McLaren & Co., St. Catharines, one 3 h.p. motor; Rat Portage, Ont., two 3 h.p. and one 5 h.p. motor; New Denver Electric Co., 500 lt. incandescent plant complete; Rat Portage Electric Co., 100 arc light automatic dynamo and lamps; Rat Portage Electric Co., one 4-panel marble plug switch board, 12 x 5, for four alternating dynamos and eight circuits and for one arc dynamo, and one power generator; Waterloo Electric Co., 1,000 light incandescent plant complete, with wiring for residences, stores, etc., 25 lt. arc plant complete, with long burning arc lamps, one marble switch board; Macgregor, Gourlay & Co., Galt, two power generators, two 8 h.p. motors, two 6 h.p. motors and wiring for 250 incandescent lamps, one marble switch board panel. The W. A. Johnson Electric Co. further reports many sales of long burning arc lamps for direct and alternating circuits, "chloride" accumulators, Wagner transformers, etc.

# Railway Matters.

THE Township of Russell, Russell county, Ont., has voted a bonus of $10,000 to the Ontario Pacific Ry. Co.

THE Restigouche and Victoria Railway Company is applying for an extension of time in which to complete surveys and begin construction.

THEOPHILE PERRAULT, Montreal, contractor, has sued C. N. Armstrong and John Rankin and the Pontiac Junction Railway Company for $788,754.

THE Lake Dauphin Railway will be extended to Mossy River this year, it is said. The company also expect to make further extensions in 1898, probably to Swan Lake district.

THE Canadian Pacific Railway Company is now constructing, at Perth, Ont., one hundred refrigerator, ten furniture and sixty dump cars, the work on which is being rushed as rapidly as possible.

THE people of Cobourg, Ont., are asking for a subsidy for the Cobourg, Northumberland and Pacific Railway, a line projected to run from Cobourg to Central Ontario Junction on the C.P.R., a distance of 50 miles

AN equalization of power is being made on the G.T.R. All the heavy locomotives are being sent to run between Belleville, Ont., and York, where the grades are the heaviest. The lighter engines will run east of Belleville.

J. H. N. MACLEOD, civil engineer for the Canadian Pacific Railway, has charge of a large and thoroughly equipped survey party which is locating the line of the Crow's Nest Pass road westward from Lethbridge, says *The Nelson Miner*.

THE Nanaimo-Alberni Railway Company, composed of Andrew Haslam, J. H. Davidson and others, is seeking incorporation for the purpose of constructing a railway about Alberni to Nanaimo, with power to operate telegraph and telephone lines, construct wharves docks, etc.

THE Restigouche Railway and Bridge Company applies for an act of incorporation to construct and operate a railway from a point of connection with the proposed railway of the Restigouche and Victoria Railway Company, at Campbelltown, N.B., to a point on the Bay Chaleurs Railway, in Quebec, and to construct, maintain and operate as a part of said proposed railway a bridge across the Restigouche River.

JUDGE OUIMET gave judgment, April 12th, in the case of A. R. McDonald, ex-superintendent of the Intercolonial Railway, against Charles Riordon of St. Catharines, the estate of the late John Macdonald and E. Boswell. The plaintiff claimed a large sum as due him in connection with the construction of the Temiscouata Railway, and the court gave judgment for $197,000, with interest for seven years at 6 per cent. An appeal will be taken.

THE following directors were elected at the annual meeting of the C.P.R., held last month in Montreal: Sir Donald Smith, G.C.M.G.; Sir Wm. Van Horne, K.C.M.G., president; Thos. G. Shaughnessy, vice-president; Richard B. Angus, Montreal; Edmund B. Osler, M.P., Toronto; Sandford Fleming, C.E., C.M.G., Ottawa; Lieut.-Gov. Geo. A. Kirkpatrick, Toronto; Geo. R. Harris, Boston; Wilmot D. Matthews, Toronto; Hon. D. MacInnes, Hamilton; Thomas Skinner, London; J. W. MacKay and Gen. S. Thomas, New York.

AT the shops of the Canadian Pacific Railway at Hochelaga, Que., there will be built this summer twenty-one locomotives for the company's service, which will include two consolidated engines for the mountain section of the road; three compound, ten-wheel engines for the Pacific section, and four of the same kind for other sections of the line; six ten-wheel passenger engines for the western division, and six of the same for the eastern division. Five first-class passenger coaches, together with baggage, express and smoking cars, will also be manufactured for use on the Toronto, Hamilton and Buffalo section.

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EDGAR FRENCH has been appointed assistant engineer of the G.T.R. western division, with office at Detroit, in place of G. Masson, retired.

R. W. BROCK, M.A., acting lecturer on mining and assaying in the Kingston School of Mines, has been appointed geologist on the Dominion Geological Survey, at $1,100 per year.

E. P. HANNAFORD, civil engineer, whose services were dispensed with some time ago by C. M. Hays, manager of the Grand Trunk Railway, when he was inaugurating changes on the road, has taken an action for six thousand dollars against the G.T.R. for wrongful dismissal.

AMONG the prominent engineers who came from the United States to Montreal to tender for the construction work on the Victoria Bridge enlargement were: Messrs. Bonzano and Clarke, New York; L. E. Todd, C. W. Bryan, S. P. Mitchell, and W. H. Cornell, Wilmington, Del.

LEWIS CARVELL, who in the early days of the Intercolonial Railway occupied the position of general superintendent, died April 13th in Toronto. Mr. Carvell's connection with the road dated back before the advent of the McKenzie Government. After some years' service he was succeeded by C. J. Brydges.

# Industrial Notes.

AN hospital is proposed for Oshawa, Ont.

WALKERTON, ONT., will build a new town hall.

GRANT & KERR'S new sawmill at Ladner's Landing, B.C., is nearing completion.

THE Canada Paper Co. is to build a pulp and paper mill at the new dam, Windsor Mills, Que.

J. FLEMING, iron founder, St. John, N.B., recently turned out a five-ton cylinder for a marine engine.

P. MCMURRAY, Welland, Ont., has invented an acetylene gas generator, to cover which he has applied for a patent.

THE Webster Combination system of steam heating is handled in Canada by Darling Bros., Reliance Works, Montreal.

IT is said that the Grand Trunk moulding shops, at present located in Hamilton, Ont., will shortly be removed to London.

J. C. FOLEY & Co., of the Foley gold mines in the Seine River district, are putting in a new saw mill of 25,000 ft capacity.

THE Rathbun Co., Deseronto, Ont., has completed four fine passenger coaches for the Montreal Park and Island electric railway.

THE Goldie & McCulloch Co., Ltd., Galt, Ont., has supplied a 150-horse-power engine to the G T.R for the car shops at London, Ont.

WALTER BEATTY, Pembroke, Ont., has the sub-contract for the carpenter work on the new C.P.R car shops at Carleton Place, Ont.

WILLIS CHIPMAN, C.E., was recently engaged to value the plant of the Barrie, Ont., waterworks, which the town proposes to take over.

A LARGE cold storage warehouse is to be built at Halifax, N.S., by the Canadian Atlantic Cold Storage Co., Ltd. The Linde system will be used.

THE Ontario Legislature, at its last session, threw out the bill to amend the Ontario Architects Act, making the association virtually a close corporation.

THE Rathbun Company, Deseronto, Ont., has received an order for 25,000 barrels of cement from the Dominion Government, to be used in canal construction.

THE Masterman Sulphite Pulp Mill Miramichi, N.B., is to be operated for a short time for the satisfaction of representatives of intending English purchasers.

DARLING BROS., Montreal, are sole agents in Canada for the Webster system of steam heating. referred to in our article on steam heating on another page.

J. B. COATES, Ridgetown, Ont., and J. and R. Nichol, Blenheim, Ont., have gone into partnership in the manufacture of staves, hoops and headings, at Ridgetown.

WILLARD KITCHEN, Fredericton, N B., has been awarded the contract for the piers and masonry on the bridge over the Memramcook River at College Bridge, N.B.

THE Owen Sound Portland Cement Co. has secured the contract for 10,000 barrels of cement to be used by the Dominion Government on the St. Lawrence canals.

THE Wm. Hamilton Manufacturing Co , Peterboro, Ont. has the contract for equipping the new Howrie saw mill at Fenelon Falls, Ont.; capacity 150,000 feet per day.

BELLHOUSE, DILLON & Co., Montreal, have secured the contract for 20,000 barrels of Portland cement, to be used by the Dominion Government on the St. Lawrence canals.

IN return for a 25 year extension of its monopoly, the Winnipeg Gas Co. proposes to reduce the price of gas to $1 80 net for lighting purposes and $1 50 net for cooking purposes.

THE Canada Carriage Co., Ltd , Brockville, proposes to establish a branch establishment at Ogdensburg, N.Y., to evade the McKinley duties to be imposed by the Dingley bill now pending.

THE bursting of the fly-wheel of an engine used for threshing on the farm of J. R. McDonald, near Cornwall, Ont., recently killed the owner of the premises and seriously injured his brother.

THE firm of Albert Holden & Co , Montreal, dealers in railway and machinery supplies. in which line they succeeded to the business of Samuel Waddell, have assigned to the court. The liabilities are scheduled at $19,780.

THE Brotherhood of Locomotive Engineers of Canada will hold its annual union meeting in Windsor, Ont., in July, the exact date not having been fixed. About six hundred members and their wives are expected to attend.

JAMES A. CANTLIE & Co., woolen manufacturers' agents, Montreal, have abandoned their estate on demand of the Bank of Montreal. Liabilities about $200,000. A number of Canadian woolen mills will be affected.

THE Quebec Bridge Co. has elected the following directors: R. Audette, Mayor Parent, J. B Laliberte, H. M. Price, Hon. J. I. Tarte, H. J. Beemer, G Lemoine, C. Duquet, J. B. Forsyth, president, A. Lavigne and J. Breakey.

NOTICE is given of application for incorporation of the Lordly Furniture Mfg. Co., Ltd., St. John, N.B. The applicants are Joseph Allison, J. A. Likely, R. G. Haley, Isaac Burpee and S. B. Lordly. The capital stock is $20,000.

RECENT experiments made at the University of Nebraska Agricultural Experiment Station, U.S., on the relative values of coal and corn (on the cob), as fuel, showed that corn at 9 cents per bushel was equal to coal at $4.87 per ton.

THE Gilmour Co. are removing a large quantity of their sawmill machinery from Trenton, Ont., to their new mill at Canoe Lake, in the Algonquin Park. They have taken away eight of the sixteen boilers and more than half the saws.

AT a meeting of the creditors of E. D. Cotterette, hardware, Montreal, he made an offer of 20 cents on the dollar. The liabilities were shown at $20,575, partly mortgaged and privileged, and assets about $15,000, but largely depreciable.

THE Holland Emery Company of Tawas, Mich , has bought the site of the Georgian Bay Lumber Company at Byng Inlet, Parry Sound, Ont., and will, it is stated, build a couple of mills and docks and bring in from Tawas its complete plant.

R. DONALDSON & SONS, machinists and iron workers, Montreal, have assigned on demand. The concern failed only last July, on which occasion the estate was bought in, and the firm reconstructed. The liabilities then were $22,000; now they owe $9,400.

A RETURN brought down in Parliament recently shows that the bounties paid on iron and steel manufactured from Canadian ore since February, 1896, is as follows: On pig iron, 42,404 tons, $84,809; iron puddled bars, 4,353 tons, $8,708; steel billets, 35,757 tons, $71,514.

THE plant and good-will of the Safe Lock Metal Shingle and Siding Company of Smithville has been bought by a new company at Preston, Ont., formed under the name of the 'Metal Shingle and Siding Company." Cyrus Dolph, J. N. Clare, and H. D. Walker, all of Preston, are the first directors, and the capital of the company is $10,000. The new company started operations last month in the Preston Carriage Company's old building.

HIS Excellency Lord Aberdeen has accepted the office of patron of the Architects' Association of the Province of Quebec, as a mark of his appreciation and good wishes for the profession in general and for the association in particular. At a recent meeting of the association, William C. McDonald, Montreal, was elected as honorary member in recognition of his great generosity in founding, endowing and equipping a chair of architecture in McGill University.

PREPARATIONS are now being made in the townships of Faraday, Dungannon, Herschel, Monteagle, Carlaw, Mayo, Bangor, Wicklow and McClure, in the county of Hastings, and by the townships of Cardiff, Monmouth and Glamorgan, in Haliburton county, for the taking of a vote on a proposal to give a bouus of $80,000 to aid in establishing a charcoal iron smelter there. Providing the bonus is passed, Manager Pusey, of the Irondale, Bancroft and Ontario Railway, says the Philadelphia Engineering Works is prepared to at once commence the erection of a charcoal furnace to cost about $200,000 in the vicinity of some of the mines along the route of the I. B. & O. Railway.


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47 Dundas St., TORONTO, ONT.
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# The Canadian Engineer

VOL. V.—NO. 2. TORONTO AND MONTREAL, JUNE, 1897. PRICE, 10 CENTS. $1.00 PER YEAR.

## The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

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### THE QUEEN.

God save the Queen! The hymn and prayer resounds throughout the world. It is echoed from a greater number of lips and hearts than any invocation or national cry since mankind began to band themselves into nations. Her name is beloved and revered, not only by her subjects, now numbering 350,000,000 people, but by millions in other nations, who, rightly reading the history of the time, know our Queen to be a lover of peace, and to be animated by the spirit of goodwill to all peoples. Millions of citizens of the United States, though owning the rule of an elected sovereign, will join the prayer for long life to the Queen, and are to-day almost as much interested as we ourselves in this jubilation for the longest reign in English history, and the longest reign of any noted sovereign of a nation prominent in the history of the world.

In the eloquent outpourings of love and devotion that will thrill through the tens of thousands of presses and pulpits this month, it is quite possible to exaggerate the personal power and the personal attributes of our Queen. Beloved though she is, we have to acknowledge that she is but human. She has no doubt made mistakes, and yet there has been no important crisis in the Empire's history where her judgment has not been guided by sound sense, and in no instance—God bless her!—has her record been tainted by an expression of cruelty or oppression. Those who have read her "Reminiscences of Life in the Highlands," or her other books, must see internal evidence of a pure mind and simple life. Her spontaneous utterance when, as a young girl, she received the announcement that she was Queen of Great Britain—"I will be good"—was the natural expression of her heart's desire.

Now the remarkable thing about Queen Victoria's call to the throne is this: that if it had been a case of election by the people she would inevitably have been passed over. The nation would have fixed on some more striking and dramatic figure—not an inexperienced maiden of negatively good qualities, but a lady of some pronounced mental qualities with something of the dash of Queen Elizabeth. Yet, as our young Queen grew into a woman, it was seen that the very absence of those dashing and brilliant qualities was the evidence of a truer greatness. It was her common sense and that excellent balance of intellect that was to make her reign far outshine the glories of the age of Elizabeth. Time alone, in the ordering of Providence, could develop the high nobility of her character, forged in the fire of personal affliction, by bereavement, widowhood and all the moulding "changes and chances of this mortal life," through which she has passed. Thus no plan of popular selection of a ruler could have brought about a reign so long and so glorious, or so abounding with mutual affection between ruler and people.

And so all hearts may join in the stirring anthem composed for this special occasion by a Canadian, the Rev. G. J. Low, of Almonte:—

A NEW NATIONAL ANTHEM.

O Lord, our God, to Thee
All praise and glory be,
Thy power we own.
For Thou hast heard our prayer,
Her life in health to spare,
For three-score years to wear
This Empire's crown.

To-day, throughout the world,
In every breeze unfurled,
Her standard's seen;
From India's coral strand,
From Afric's golden sand,
Resounds the anthem grand,
God Save the Queen.

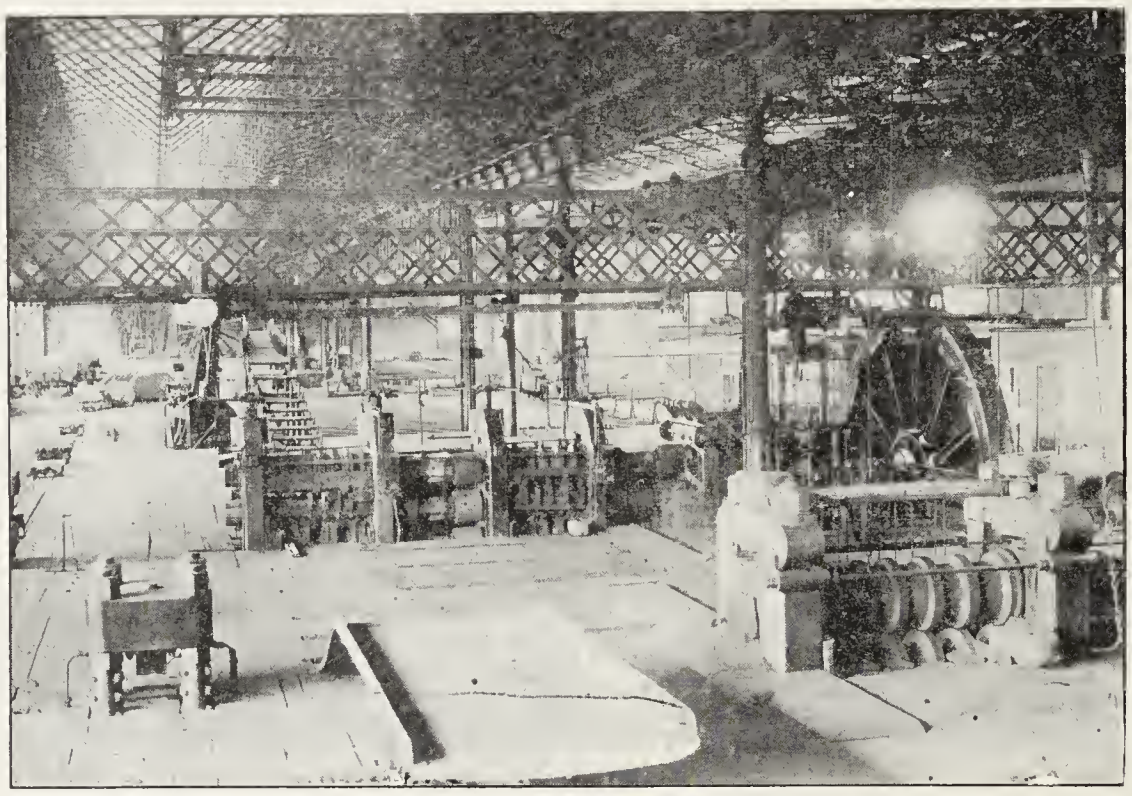
And Canada that links
The two great oceans' brinks,
Repeats the strain.
To keep our own wide land
Part of that Empire grand
We'll work with heart and hand,
With might and main.

Her Empire's vast increase
In power, in wealth and peace,
Her reign has seen;
Of ev'ry race and creed,
From all oppression freed,
Her subjects ever plead,
God Save the Queen.

## BRITISH RAILWAY ENTERPRISE.

*(Correspondence of* The Canadian Engineer.)

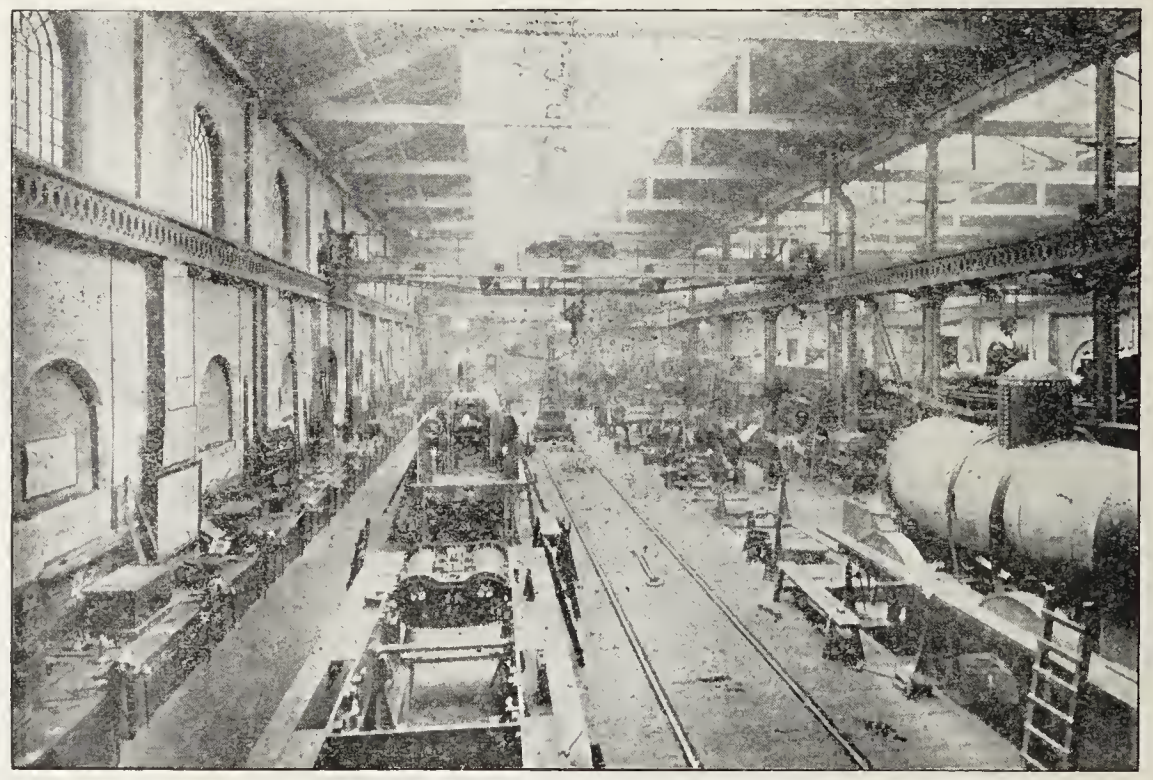
My letter under this head last month made some general comparisons between the railway systems of Great Britain and the United States, and showed that in the great essentials of safety of passengers, speed and economical administration, as well as profits to investors, the railways of Great Britain take the lead.



RAIL MILL, CREWE WORKS.

This, my concluding letter, will give some more concrete facts concerning the magnitude of the operations of a great British railway. In doing this I have singled out the London and North-Western Railway, not only because it is the largest railway corporation in the world, but because it is one of the best administered, and withal most popular with Canadian and American visitors to England. I gave incidentally some figures showing the splendid equipment of this road, and the admirable training of its officers and men, as shown in their ability to handle such enormous crowds of passengers and quantities of freight as they are called upon at times to transport. Figures are not always dry, and certainly the figures with which one is required to deal in describing the work of a great corporation like this, are eloquent in themselves. The capital of the London and North-Western Railway is a little over $600,000,000, the magnitude of which will be realized when I mention that the total capital invested in all the industries of Canada of whatever kind is, according to the census of 1891, $354,620,750. The report of the company for the half year ending June, 1896, shows that the following passengers were carried: First class, 981,785; second class, 1,461,405; third class, 33,416,013; season tickets, 41,815, or at the rate of nearly 72,000,000 per year, and so far as I know not a single passenger's life was lost. This total more than equals the population of the United States, Canada and Newfoundland combined. In one week last year (that before the Bank holiday) the passenger traffic receipts were $1,560,000. And yet the total mileage of the London and North-Western, including leased lines, is only 1,912. The return of rolling stock at the meeting referred to showed 2,335 engines, 1,778 tenders, 4,369 passenger cars or "coaches" of various classes, and 65,850 cars for various classes of freight. This is exclusive of "duplicate working stock," among which are 445 engines. The company also own 4,078 horses—enough to make a strong cavalry force for an army, while its human employes, numbering 60,000, would certainly make a respectable army. The bill for coal and coke for the locomotive department for the past year was $1,975,000, and for "oil, tallow and other stores," for the same branch, $131,740. It requires $12,500 a day to keep the road in proper repair, the approach roads, bridges, signals and like items costing $700,000, and $500,000 a year goes in painting and repairing, besides $150,000 in rebuilding. Over $360,000 a year is spent for new ballasting alone. Every foot of the line is inspected every day, and every signal cabin along the whole system receives inspection each fortnight. In the signal department there are eleven inspectors with 500 foremen, "chargemen," and artisans, and the rodding they deal with would extend from Land's End to John O'Groats, and the wires would more than stretch across the Atlantic from Liverpool to New York. There are 18,000 signals and 1,500 signal cabins, there being nine complete cabins turned out each week at the works at Crewe, to replace worn out ones, some of them having twenty-four arms.

To keep the rolling stock of the London and North-Western in repair costs about $1,500,000. A third class passenger car costs in England about $3,000, and a first class composite one about $4,000, and each vehicle gets sixteen coats of paint before it is finished.

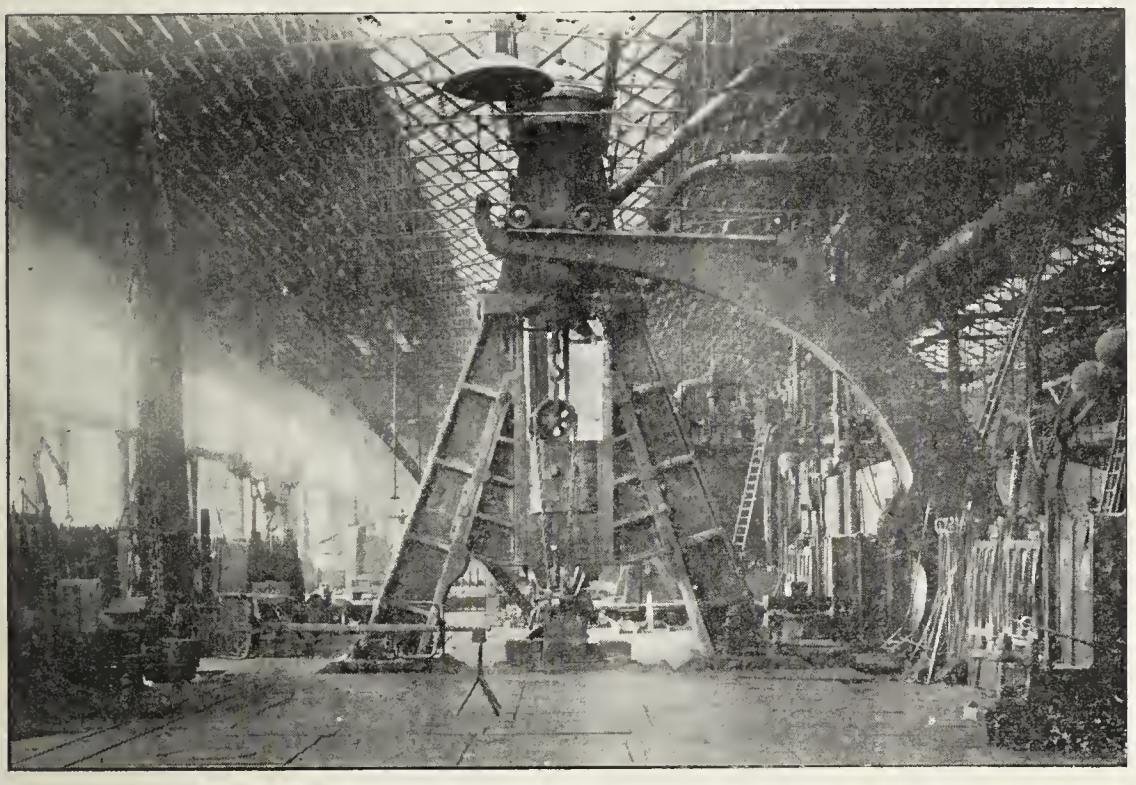


ERECTING SHOP, CREWE WORKS.

So much of the work of car building is done by machinery that the item of labor only costs $100 per car. The car works are at Wolverton, and employ 3,500 men; the goods trucks, or open freight cars, are built at Earlestown, near Liverpool, and employ 2,000

hands, and the cost of maintaining the rolling stock—exclusive of engines—is $2,100,000 a year.

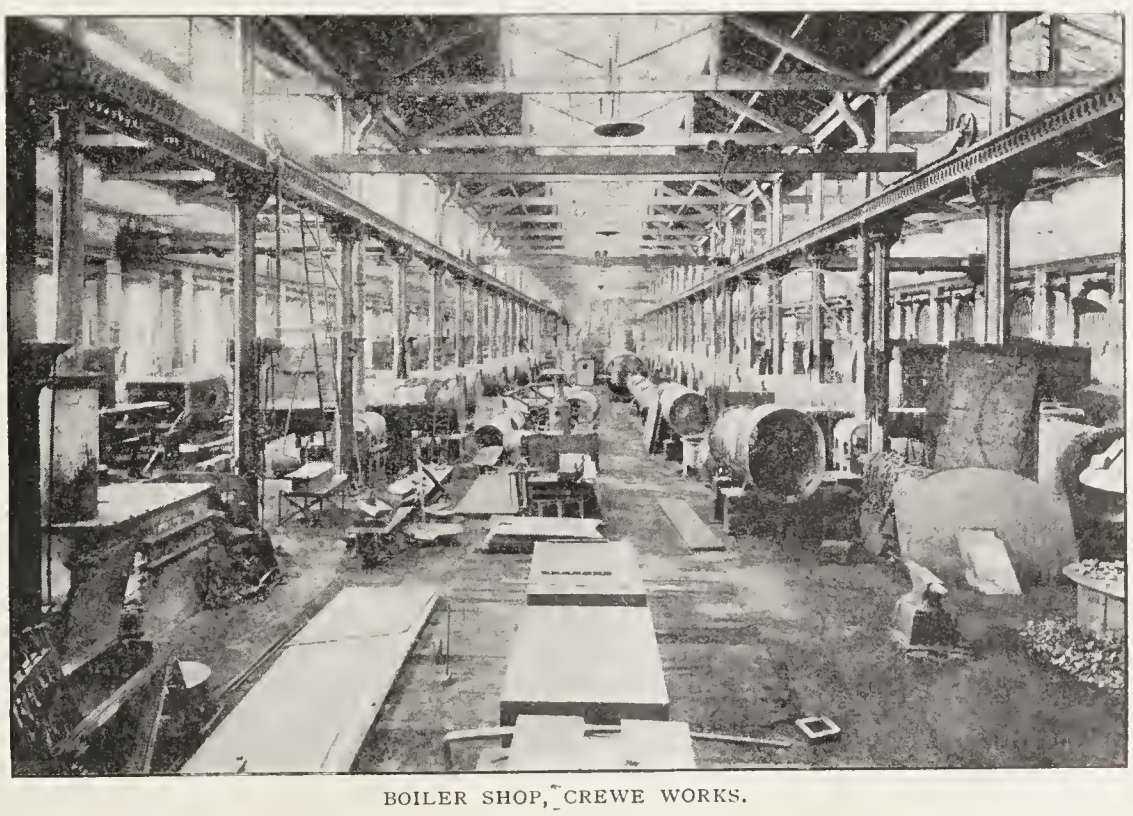
The locomotive shops of the London and North-Western are at Crewe, and to the mechanical mind this is the centre of attraction of the system. It is marvellous to think of a town of this size being solely the creation of a railway company, and fulfilling the needs of only one department of it at that. On the 4th July, 1837 (the year the Queen came to the throne), the first train passed through Crewe, then a hamlet of 148 souls; now it is what Canadians would call a "city" of over 30,000, the whole population depending on or working in the shops of this railway. In 1843 the shops occupied less than three acres of ground, and employed 161 hands; now they cover over 120 acres and employ over 7,000. The town has a Mechanics' Institute, built and maintained by the company, and connected with it is a Science and Art School, whose students have won more Whitworth scholarships than any other place in England. It has a volunteer engineer corps, 600 strong, composed entirely of men in the works. The shops have their own fire brigade, and similar organizations, all very efficiently maintained. The parliamentary division is now named after the town, which contains more than half the electorate.*



EIGHT-TON STEAM HAMMER, CREWE WORKS.

The first locomotive superintendent at Crewe was F. Trevithick, son of the great Trevithick, who, in 1805, brought out his wonderful "steam coach" and exhibited it on the very site now occupied by Euston station, the London and North-Western's London headquarters. In Trevithick's time the company had only 75 engines in stock.

At the Crewe shops, which now employ over 7,000 men, the company makes its own steel, has seven furnaces for steel of the Siemens-Martin process. The London and North-Western is the only English company that rolls its own rails, and a view of one of the rail mills is shown in one of the illustrations. The plant has a capacity of 45,000 tons of rail per year, and actually produces about 30,000 tons. The mill is driven by a 700 h.p. Corliss engine. An ingot of steel 3 feet long and 10½ inches square is taken out of the furnace and fed to the jaws of the swiftly revolving rollers of the mill. The ingot in passing to and fro in these grooves becomes longer and thinner with each squeeze; and finally, when it is formed into rail shape in the last pair of rollers, it is carried on smaller rollers to a circular saw, where the ends are cut off as easily as a scantling of wood is sawn off in a lumber mill, and we behold a finished rail 30 feet long and weighing 90 lbs. to the yard, the whole process of making the rail occupying only a minute. "Within the works," writes W. J. Gordon in an article on this town in *Pearson's Magazine*, "there are five miles and more of the pigmy track of 18-inch gauge which covers the floor of its shops like a spider's web, on which run the miniature engines that once replaced the horses on the Shropshire Union Canal. Anything in the metal way used in railway practice you can get at Crewe from start to finish. You can see the steel made in the converters with all their roaring pyrotechny, and you can follow it from point to point, until it moves off by itself on the rails (made from the same converter), and flies north or south on its trial trip at 50, 60, 70, aye, 80 miles an hour." To build an engine in the ordinary way takes four weeks, but one engine was built here in the space of 25½ hours. The process of erecting an English engine is as follows: The different parts, such as boilers, frame plates, cylinders, axles, etc., being previously made in their respective shops, are brought here to the erecting shops, where first the frame plates are fixed by temporary cross-bars into the place they will occupy when the engine is complete. The cylinders and foot plate are then fixed in position, and when the skeleton is complete the boiler is lifted on by a crane. Then the cylinders are fitted in, and the wheels (which are usually of cast steel, and to which the axles have already been fitted) are then run under and the frame lowered down on them. The



BOILER SHOP, CREWE WORKS.

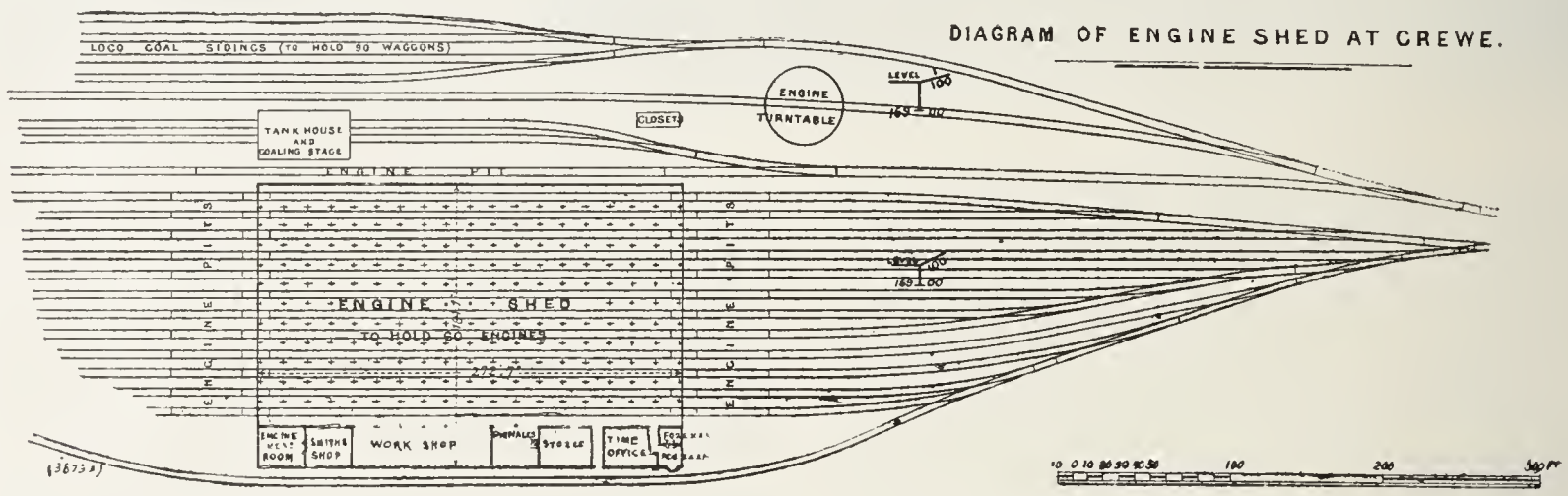
*For a fuller description of Crewe and its shops see article in *English Illustrated Magazine*, Feb., 1892, by C. J. B. Cooke.

next work is the connecting of the rods and all the intricacies of the valve motion, and then all the internal and external fittings are completed. Before she is taken to the paint shop and polished up, she is sent out on her trial trip. As mentioned before, over 2,000 engines pass through these shops each year for overhauling and repair, and all the engines of the line consume about 3,500 tons of coal per day.

In the wheel shop some very fine machine tools are to be seen. Some of the lathes are capable of turning a wheel nine feet in diameter. One machine called a "roughing lathe," has seven tools all employed at once in taking a rough cut off the crank axle, tearing the steel away in huge bites and making the axle ready for the finishing tool. A "nibbling machine," with 160 cutting tools, eats its way into the solid forging of a crank and cuts out the "throw" or inner bend of the crank. The boiler shops, a view of which is here given, employ several hundred hands, and the noise of riveting is like the roar of a tropical hail storm.

A new engine shed has just been completed, after a design by F. Webb, the able superintendent, to hold 60 standard tender engines. It is a "through and through" shed, and will be used principally for the "turnback" engines arriving at Crewe with goods trains from either the north or south. These will pass into the shed at one end as they come off work, and after cleaning, will come out at the other end for the return journey. The length is 272 feet 7 inches, whilst the breadth is 184 feet 1 inch. All the ironwork is made to template and to standard patterns, so that any part will fit any similar shed, many of smaller dimensions having been erected at different points of the company's lines. The arrangement of tracks is shown in the diagram, which is reproduced from *Engineering*, of London.

DIAGRAM OF ENGINE SHED AT CREWE.




To finish with a few more general statistics. The wages bill of the traffic department of the London and North-Western is $8,455,000 a year; over $1,000,000 a year is spent in fuel and light for the waiting rooms and cars; the uniforms for the men cost $150,000 a year, and the printing and stationery amounts to over $300,000, the actual weight of tickets sold being about 70 tons a year. The passenger trains run over twenty-one million miles a year, and the goods trains (freight) nearly as many, making a total of forty-one million miles. The receipts from passengers and freight make an annual total of over $32,500,000, and the total weight of passengers and freight thus carried is estimated at 38,000,000 tons.

But, as Mr. Gordon says in the article previously quoted, "there is a North-Western afloat as well as a North-Western ashore; the company is not only a railroad owner, but a canal owner and a steamboat owner. It pays over $57,500 a year in light and harbor dues; its steamboat repairs cost over $75,000 a year; its marine coal bill is over $90,000 a year, and the manning of its fleet costs $215,000 a year. Altogether it spends a trifle under five hundred thousand a year on its steamers. And its canals at Lancaster and Huddersfield cost over $35,000 a year. During the same period it paid the Government $75,000 as passenger duty, and its rates and taxes reached the enormous total of over $750,000. Its telegraphing costs $285,000 a year. To its superannuation fund, insurance, provident and pension societies and schools it gives $225,000 a year. Curiously enough, it has among its directors one that is hereditary, as the Great Western has one in Sir Watkin Wynn. This is the Duke of Sutherland, whose father is still known in railway circles as "the real live duke," from an incident which occurred on a line contrasting very decidedly with the North-Western, being that in Sutherlandshire, in the Dunrobin and Helmsdale country, which his Grace practically paid for out of his own pocket. One day he was driving the express on this line as the train passed two navvies. 'There Bill,' said one of them, 'that's what I calls a real live dook; he's a-driving his own engine on his own line, and burning his own blessed coals!' He would be a rich man of whom that could be said on the North-Western."

*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### ARTICLE III.—TRAFFIC.

Wellington demonstrates that the traffic revenue increases with the (*population per mile of railway*) $^2$.

This is based on the rough assumption that the volume of traffic increases as the distance between two towns diminishes, or that the gross traffic receipts between two towns is nearly a constant, and thus if on a given line we have two traffic points and call traffic 1. Then with three traffic points the traffic $= 1 + 2$, and with $n$ traffic points the traffic $= n\frac{(n-1)}{2}$, or when $n$ is large we may neglect the second term and say that the traffic for $n$ points $= \frac{n^2}{2}$. Now if we apply this to the individual as a unit, we may deduce the general statement given above. This assumption is not tenable when applied to a special commodity which originates at a fixed place, such as coal. Because the traffic is the same for two towns 150 miles or 15 miles from the coal pit, depending entirely on the demand for coal, on the other

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

hand it is augmented by the fact that short haul rates are usually higher than long haul for the same service. Even this consideration, however, will not hold at the present day for suburban steam traffic, because it is being terribly crippled by electric suburban railways. On the whole, it is probably still true for a road of considerable length of general traffic, not largely suburban.

This view is upheld by the following table of the internal traffic of New York city:

| Year. | Population. | Trips per year per inhabitant. | Value by $(n)^2$ Formula |
|---|---|---|---|
| 1860 | 814,000 | 45 | 45 |
| 1870 | 942,000 | 122 | 60 |
| 1880 | 1,206,000 | 175 | 99 |
| 1885 | 1,393,000 | 213 | 132 |

By which we see that the gross returns exceeded the ratio of $(population)^2$, but as the length of haul also increased it is probable that the net revenue about followed the law given. The following table, also, of a broader and more general character, confirms the view given:—

TABLE I.

SHOWING INCREASE OF POPULATION AND RAILWAY EARNINGS IN UNITED STATES AND CANADA, 1870 TO 1895.

| | Year. | Miles of Railway. | Gross Earnings ÷ 10,000 | Population ÷ 100,00 | (Col. iv.)$^2$ | Rates of Col. iii. Col. v. |
|---|---|---|---|---|---|---|
| Canada. | 1875 | 4,300 | $1,958 | 39. | 1,521 | 1.29 |
| | 1880 | 6,800 | 2 355 | 43. | 1,849 | 1.27 |
| | 1885 | 10,200 | 3 223 | 45. | 2,025 | 1.59 |
| | 1890 | 13,100 | 4,680 | 48. | 2,304 | 2.03 |
| | 1895 | 16,091 | 4,680 | 51. | 2,601 | 1 79 |
| U.S.A. | 1870 | 54,000 | 37,000 | 385 | 148,225 | .249 |
| | 1875 | 74,000 | 50,000 | 440 | 193,600 | .258 |
| | 1880 | 94,000 | 60,000 | 501 | 251,000 | .239 |
| | 1885 | 128,000 | 77,000 | 565 | 319,225 | .241 |
| | 1890 | 166,000 | 120,000 | 626 | 391,876 | .307 |
| | 1895 | 180,000 | 107,500 | 690 | 476,100 | .225 |

This table shows (assuming that the population served per mile of railway increases in the same proportion as the population of the country as a whole does) that the gross earnings, both in Canada and the United States, have increased more rapidly than the $(population)^2$; however, the rapid falling off from 1890 to 1895 in both countries suggests that this may not entirely hold true in the future.

As another indication of the same law, compare Canada and United States for 1895. (See Table II.)

| | Gross Earnings per Mile. | (Pop. per mile of Railway)$^2$ |
|---|---|---|
| Canada | $2,908 | $(317)^2 = 100,489$ |
| U.S.A. | 5,945 | $(382)^2 = 145,924$ |

Which shows that the gross returns per mile of railway are even more than in the proportion of "square of population per mile of railway."

In any given case it will be difficult to estimate the actual tributary population, which may be decreased by competition, increased by feeders or affected by industrial conditions, but if applied on a large scale to eliminate irregularities, we may look on it as quite accurate enough to guide us in comparisons of routes. Thus, supposing a railway by altering its general location can be made to serve 1,200,000 people instead of 1,000 000, we may estimate its gross returns to be increased from 100 to 144, or 44 per cent., while if the road is not materially longer, or poorer physically, the increase in operating expenses will be much less in proportion.

Revenue is often considered to be injured by a long line between terminals, but this is, largely, a mistaken idea; the only case in which it is true is when there is keen competition between two places, by two or more routes, in which case the rate is fixed by the shorter line, but in non-competitive and local traffic, or even in the case of a road forming one link in a trunk line, rates are fixed by the mile or divided on a mileage basis, so that if a road can be located through more populous districts, built cheaper or with lighter grades, then the advantages of higher traffic charges, greater volume of traffic, less working expenses and fixed charges may any or all be in favor of the longer line. Incidentally, in Canada bonuses are often given on a mileage basis. These remarks apply only to moderate increases in length of line of from 5 to 10 per cent.

The folly of long tangents, creating more first cost, and often missing local traffic points, is a blunder somewhat common; the idea of serving the public by passing through the *very heart* of each populous district should be more fully appreciated, for ultimately, whatever traffic a road may have is from door to door, including cartage and bus fares; most evidently is this so at competing points. But the most important effect is that a good railway service convenient to the public will foster and increase traffic, while a town given the go-by for the sake of saving a little in land damages, or distance, has often had its prospects blighted forever; it is most important that a road should establish large roomy depots and obtain plenty of yard room while land is inexpensive, in anticipation of future growth on the part of any prosperous town. Wellington estimates the loss of traffic for each mile a depot is distant from the centre of population at from 10 per cent. to 25 per cent., being greatest at competing points and in manufacturing towns.

TRUNK LINES.

Most trunk lines are liable to suffer from competition, and, to protect themselves, buy or build feeders, and this has concentrated railways into large systems, but a general rule is to link together the largest possible population, quite regardless of minor losses in distance. The limit should never be approached when the increase in revenue is no greater than the increase in length of line, or when differences of distance are so great as to discourage traffic or encourage the construction of a competing road, and an exception might also be made in the case of being able to pass midway between two towns and serve them fairly well by branches.

The N.Y.C. & H.R.R. is a striking example of a road much longer than any of its competitors, but with light grades and a heavy tributary population, it is largely independent of its through traffic, and can handle it as "excess traffic" at a very low rate; on the other hand, the Pennsylvania R.R., soon after its completion west, built feeders in every direction, and thus held traffic that would otherwise soon have passed into other hands owing to its heavy grades.

Other general conclusions regarding trunk lines are:

(1) That they should never attempt to make a small sea or lake port a terminal, but have the largest possible terminals even at the expense of considerable extra distance. As instances of this, witness the Intercolonial making arrangements to enter Montreal, the Erie Railway abandoning Dunkirk as a terminal and building into Buffalo, and the Mexican National attempting to establish a port at Corpus Christi, instead of Galveston, which proved a failure.

## TABLE II.—RAILWAY STATISTICS, 1895.

CAPITALIZATION, FIXED CHARGES, WORKING EXPENSES, EARNINGS, ETC.

| Item. | Canada. | | Great Britain. | | United States. | |
|---|---|---|---|---|---|---|
| | Total. | Per Mile. | Total. | Per Mile. | Total. | Per Mile. |
| Mileage | 16,091 | ..... | 21,174 | ..... | 180,657 | § |
| Population | 5,100,000 | 317 | 39,300,000 | 1,856 | 69,000,000 | ¶ 382 |
| Square miles | 1,609,000 | ..... | 120,800 | ..... | 2,970,000 | ¶ |
| Population per square mile | 3.2 | ..... | 325 | ..... | 23.2 | ..... |
| *Capitalization.* | | | | | | |
| Bonds | $330,786,000 | $20,557 | $1,800,906,000 | $85,000 | $5,407,000,000 | $30,000 |
| Preferred stock | 105,680,000 | 6,568 | 1,236,446,000 | 58,400 | 759,000,000 | 4,200 |
| Common stock | 255,769,000 | 15,897 | 1,772,862,000 | 83,700 | 4,961,000,000 | 27,400 |
| Loans and floating debts | 37,626,000 | 2,338 | 67,196,000 | 3,100 | 616,000,000 | 3,500 |
| Bonus and Government aid | 167,523,000 | 10,411 | ..... | ..... | ..... | ..... |
| Total | $897,384,000 | $55,761 | $4,875,410,000 | $230,200 | $11,743,000,000 | ‖$65,100 |
| *Earnings, Etc.* | | | | | | |
| Passenger | 13,311,440 | 827 | 181,949,000 | 8,593 | 252,000,000 | 1,390 |
| Freight | 29,545,490 | 1,836 | 214,450,000 | 10,033 | 730,000,000 | 4,040 |
| Other | 3,928,560 | 245 | 22,044,000 | 1,136 | 93,000,000 | 515 |
| Total | $46,785,490 | $2,908 | $418,443,000 | $19,762 | $1,075,000,000 | $5,945 |
| Working expenses | 32,749,670 | 2,035 | 233,159,000 | 11,011 | 726,000,000 | 4,020 |
| Net earnings | $14,035,820 | $873 | $185,284,000 | $8,751 | $349,000,000 | $1,925 |
| Per cent working expenses to gross earnings | .70 | ..... | 55¾ | ..... | 67½ | ..... |
| Per cent. net earnings to total capitalization | 1.56 | ..... | 3.80 | ..... | 2.97 | ..... |
| *Fixed Charges.* | | | | | | |
| Bond interest | *$15,287,250 | (4 62%) | ‡$121,494,000 | (4%) | $240,000,000 | (4.42%) |
| Other interest on loans, rentals, etc. | †1,881,300 | (5 0%) | ‡ 2 688,000 | (4%) | 53 000,000 | ..... |
| Total | $17,168,550 | ..... | $124,182,000 | ..... | $293,000,000 | ..... |
| Net income | — 3,132,730 | ..... | 61,104,000 | ..... | 56,000,000 | ..... |
| Stock-bearing dividends | ..... | ..... | 1,538,920,000 | ..... | 1,716,000,000 | ..... |
| " not " | ..... | ..... | 233,760,000 | ..... | 3,245,000,000 | ..... |
| Dividends declared | ..... | ..... | 61,104,000 | ..... | 85.000,000 | ..... |
| Taken from surplus, or borrowed | ..... | ..... | ..... | ..... | 29,000,000 | ..... |
| Passenger charge per mile | Estimated 2·5c. | ..... | 2.1c. | ..... | 2.07c. | ..... |
| " per ton-mile | " 1¼c. | ..... | 2.0c. | ..... | .84c. | ..... |
| Earnings per passenger train-mile | 87c. | ..... | 99c. | ..... | 77c. | ..... |
| " " freight " | $1.48 | ..... | $1.43 | ..... | $1.49 | ..... |
| Average cost per train mile | 80½c. | ..... | 64⅔ | ..... | 87c. | ..... |

* Includes 4½ per cent. on $14,212,000 bonds of which rate of interest is not obtainable. † Estimated at 5 per cent. ‡ Estimated at 4 per cent. on bonds and preferred stock. § Not including extra tracks. ¶ Only explored regions of Canada are counted in this calculation. ‖ U.S. stock heavily watered.

## TABLE III.—RAILWAY STATISTICS, 1895.

TRAFFIC, EQUIPMENT, ETC.

| Item. | Canada. | | Great Britain. | | United States. | |
|---|---|---|---|---|---|---|
| | Total. | Per Mile. | Total. | Per Mile. | Total. | Per Mile. |
| Gross earnings per inhabitant | $9 00 | ..... | $10 60 | ..... | $15 60 | |
| *Passenger Traffic.* | | | | | | |
| Number of passengers | 13,987,580 | 870 | 930,967,000 | 43,900 | 543,000,000 | 3,066 |
| Passenger cars | 1,994 | 12/100 | 42,230 | 2. | 33,112 | 18/100 |
| Average haul (miles) | 38* | ..... | 8 | ..... | 23 | |
| Average load | 35* | ..... | 49 | ..... | 39 | |
| Passenger cars per 1,000,000 passengers | 143 | ..... | 45 | ..... | 65. | |
| Passenger train miles | 15,332,276 | ..... | 184,200,000 | ..... | 327,294,000 | |
| Passenger trains per day (each way)† | 1¼ | ..... | 12 | ..... | 2½ | |
| *Freight Traffic.* | | | | | | |
| Tons of freight | 21,524,421 | 1,340 | 334,230,000 | 15,800 | 763,000,000 | 4,230. |
| Freight cars | 52,118 | ..... | 603,710 | ..... | 1,196,119 | |
| Average haul (miles) | 110* | ..... | 35 | ..... | 116. | |
| Average load (tons) | 119* | ..... | 73 | ..... | 180. | |
| Freight cars per 1,000,000 tons | 2,421 | ..... | 1,806 | ..... | 1,717 | |
| Freight train miles | 19,939,699 | ..... | 150,400,000 | ..... | 491,410,000 | |
| Freight trains per day (each way)† | 1 7/10 | ..... | 9 7/10 | ..... | 3 7/10 | |
| *Mixed Traffic.* | | | | | | |
| Various kinds of cars‖ | 5,999 | ..... | 31,088 | ..... | 41,330 | |
| Mixed train mileage | 5,389,915 | ..... | 4,300,000 | ..... | 15,457,000 | |
| Mixed trains per day (each way)† | ½ | ..... | 3/10 | ..... | ⅛ | |
| Total trains per day (each way)† | 3 46/100 | ..... | 22 | ..... | 6 33/100 | |
| *Engines.* | | | | | | |
| Total number | 2,023 | ..... | 18,658 | ..... | 35,111 | Including switching engines. |
| Average yearly engine mileage‡ | 20,100 | ..... | 18,160 | ..... | 23,760 | |
| Employees | 55,000 | ..... | 465,112 | 22. | 785,000 | 41 4/10 |
| " killed | 50 | ..... | 442 | ..... | 1,811 | |
| " injured | 488 | ..... | 2,654 | ..... | 25,693 | |
| Passengers killed | 9 | ..... | 83 | ..... | 170 | |
| " injured | 60 | ..... | 1,109 | ..... | 2,373. | |
| " killed, 1 in | 1,554,000 | ..... | 11,202,059 | ..... | 2,984,000 | |
| " injured, 1 in | 233,126 | ..... | 838,387 | ..... | 213,000 | |

* Based on assumed average passenger and freight rates. † 365 days in a year. Train each way called "one train per day."
‡ Including switching engines. ‖ Express, Baggage, Postal, Sleepers, Dining Room, Transportation Co.'s Cars, etc.

(2) That after joining together as large a population as possible without unduly lengthening their line, they should build or buy such a system of branches, as feeders, as will draw to the main line as large a volume of traffic as possible, even in the face of competition. No better example of this can be given than in the Province of Ontario, where the G.T.R. and C.P.R. both endeavor to have feeders in all directions, and fight each other in many towns. Almost all the independent small lines of that Province have disappeared.

*Branch Lines.*—Branch lines are usually unprofitable in themselves, *e.g.*, Midland Railway of Canada, a network of short lines operated by the G.T.R. at a yearly loss, for the purpose of securing a large volume of freight for its main line, and preventing the C.P.R. from getting it. This is the reason, in almost all cases, which causes the most prosperous roads to operate them, to swell the trunk line traffic, because once any branch line traffic is delivered to the main line, it being *extra* traffic, is very profitable, often costing almost zero to handle, while the toll collected is for the whole trip. Putting the cost of handling the unit of minimum traffic on a main line at 100, the cost of handling a single extra passenger or small parcel of freight is almost zero: in car load lots at 10 to 30 per unit, and in train load lots at about 50 per unit.

A branch line, however, usually costs nearly as much per mile to build as a main line, and nearly as much to maintain—certainly far more than in proportion to the traffic; so that we can usually lay down a rule of branch line location to make it strike the main line as soon as possible, but meet it at a town if possible in order to give the branch more return freight; country junctions of branches are deadly in their lack of traffic (other things being equal), therefore branch lines should rather be numerous and at right angles, or nearly so, to the main line, than to run parallel to the main line for any great distance, stringing together unimportant hamlets before joining the main stem.

*Volume of Traffic.*—The volume of traffic by Table III. is shown to be about $9 per head, per year, in Canada, and $15.60 per head, per year, for the United States. We may not assume, however, that it is uniform in Canada; but varies probably as rapidly as the square of the density of tributary population. The average town would probably be about $10 per year, per head, increasing to very much more for large towns and cities. The class of town also has a great effect; an industrial town such as Galt, Ontario, would afford far more traffic per head than such a town as Whitby or Cobourg, owing to the pursuits of the inhabitants being different. The great volume of suburban traffic cannot be counted on in the future, as the cheap roadbed, etc., few restrictions, frequent service, and convenient depositing of passengers, enables electric lines to serve such a traffic very successfully. This is a serious problem for steam roads to face, as suburban traffic has been, in the past, a very profitable feature to many roads.

### INCREASE OF TRAFFIC.

The per cent. which operating expenses bears to the gross revenue varies enormously. Roughly speaking, the road which economizes in its investment, on which it pays interest, is apt to have heavy operating expenses. This percentage in Canada varies from 256 per cent. to 43 per cent., with an average of 70 per cent. for Canada in 1895.

These working expenses may be roughly divided as follows:—

| | | |
|---|---|---|
| (1) Maintenance of line and buildings ..... | 15 | 70 |
| (2) Working and repairs of engines ..... | 22 | |
| (3) " " cars ..... | 6 | |
| (4) General expenses ..... | 27 | |

Now careful estimates show that only about half of these expenses are increased by an increase of traffic beyond a meagre minimum, which is the reason why it is so important to select a route giving the most traffic, as it is the *increase* of traffic over that which gives profit enough to pay fixed charges, to which we must look for profit to the stockholders, and a very moderate difference in first cost, revenue or working expenses means success or failure.

In any young country like Canada traffic increases rapidly at first, the increase being twofold: (1) A natural increase due to increased population; (2) An increase fostered by the newly discovered wants of a people not before served by a railway, the critical period of a road's history being usually the first few years of its existence, before a solid, steady revenue has been secured.

In England, New England States or Eastern Canada, the growth of traffic may be estimated at 5 to 6 per cent. per year for a given line. While in Western America or any new country, 10 to 15 per cent. per year will not be too much to figure on. The usual way of estimating traffic is by the number of trains per day over roads of certain maximum grades; but on roads of small traffic, which do not wish to run less than one train per day each of freight and passengers, the trains are not apt to be loaded well, and again two trains per day will be considered necessary to accommodate the people long before they will be regularly filled, so that it is only on roads of heavy traffic that it can be divided into the number of trains that will just accommodate it.

### ARTICLE IV.—RECEIPTS.

Referring to Table II., "Railway Statistics," it will be seen that American freight charges are lower than English with a less volume of traffic. This anomaly is explained by the frequent, lightly-loaded freight trains of England run at a high speed, with small cars and heavy terminal charges. An adoption of heavy American cars, larger trainloads, and a slightly decreased speed, with perhaps five freight trains per day instead of ten, would enable English freight rates to be lowered more than one-half, and effect an enormous economy. Partly due to high rates on freight, but chiefly due to enormous traffic, the receipts on English roads are nearly $20,000 per mile per year, as against $5,900 per mile per year in the U.S.A, and $2,908 per year per mile in Canada; operations for 1895 showed net earnings to be 3.8 per cent. interest on gross capitalization of English roads, as compared with 2.97 per cent. per year in the U.S.A., and 1.56 per cent. per year in Canada.

This great difference, in spite of the capitalizations of the railways, per mile of railway, being $230,000 for Great Britain, $65,000 for U.S.A., and $55,760 for Canada, is due to two distinct causes, (1) volume of traffic, (2) decreased percentage of operating expenses to gross earnings due to this increased traffic, the net earnings being $8,751 per mile for England, $1,925 for U.S.A., and $873 for Canada. Let us now discuss the position which Canadian railways occupy financially, first taking Canadian railways as a whole, and, second, classifying them:

ARTICLE V.—CANADIAN RAILWAYS.

The returns for 1895 are about as poor as could be selected, and those just handed down for 1896 show a slight improvement, but this may be due to temporary retrenchments, which have to be made up for sooner or later, such as track and car economies, by letting the condition run down slightly. The net earnings of Canadian railways of $873 per mile give net receipts of $14,035,820, but the interest on bonded debts, and estimated amount of loans, etc., amounts to $17,168,000* (approx.), or a net loss of over $3,130,000, and nothing with which to pay interest on the $167,000,000 that the various Governments have given either in the form of an investment in Government railways or as bonuses, and nothing with which to pay dividends on stock. This does not look encouraging; competition and popular clamor keep rates down to the lowest possible notch, and so long as our traffic is small it seems certain that, considering the severe climatic conditions under which our roads are operated, and the evident economy of management (70 per cent. of gross receipts as compared with 67½ for U.S.A.), the present rates must be fully maintained, if not raised. The stock of Canadian railways is not all real, but estimating that one-half is real and one-half water, we have $180,000,000 invested bearing no interest, besides the $167,000,000 which the people of the country have sunk in them in order to have sufficient railway accommodation. Even neglecting interest on all loans, floating debt, etc., there is still a deficit on bond interest of $1,252,000, which is met year by year by issues of more bonds and stock, or by creating floating debts which are periodically so converted; we go on year by year mortgaging futurity. It is hoped that in a few more years increased traffic will enable the bond interest to be fully met, and in this the increased solidity of permanent way will greatly aid. The average cost per train mile is very low (80½c.), considering our high price of coal, severe climate, rather inferior road beds, small number of trains per day, and good wages paid; it reflects great credit on Canadian management as a whole.

Let us now analyze Canadian workings by dividing the roads into four groups. (See Table IV).

(1) *Canadian Pacific Railway System.*—This road shows a low bonded debt, moderate stock, and high Government aid per mile (much of this latter, however, being tied up yet as land grant); on this account, and because it can charge higher rates in the west, it is enabled to keep its net earnings large enough to pay bond interest, and on prosperous years has considerable left over to pay dividends on stock. If dividends were declared in 1895, they were drawn quite justifiably from the surplus; but on the whole, the C.P. Railway by a very efficient management, high train-mile earnings ($1.45), and low first cost, is by far the most prosperous of Canadian railways, in spite of such low gross earnings as less than $3,000 per mile. The future increase of traffic in the North-West will enable it to lower its rates and still make a profit; but for the present, it is hardly clear how this can be done. The C. P. Railway also has the advantage of new equipment which does not need such heavy repairs. It is gradually improving its road-bed by the construction of masonry and steel in place of wooden structures.

* This is based on the assumption in Table II. that the interest on loans, floating debts, etc., is 5 per cent.; probably a large proportion of it bears no interest.

TABLE IV.—ANALYSIS OF WORKINGS OF CANADIAN RAILWAYS FOR 1895.

| | Main Line. | | Branches. | | Total. | | Dominion Government Railways. | | Remaining Railways of Canada. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total. | Per mile. | Total. | Per mile. | Total. | Per mile. | Total. | Per mile. | Total. | Per mile. |
| **GRAND TRUNK RAILWAY SYSTEM.** | | | | | | | | | | |
| Miles | 884 | ..... | 2,280 | ..... | 3,164 | ..... | 1,382 | ..... | 5,261 | ..... |
| *Capitalization—* | | | | | | | | | | |
| Bonds | $ 75,243,000 | $ 85,100 | $33,649,000 | $14,800 | $108,892,000 | $34,400 | ..... | ..... | $75,944,000 | $14,400 |
| Preferred stock | 89,544,000 | 100,900 | 2,556,000 | 1,100 | 91,800,000 | 29,000 | ..... | ..... | 3,871,000 | 700 |
| Common stock | 109,383,000 | 123,700 | 50,000 | ..... | 109,433,000 | 34,600 | ..... | ..... | 68,926,000 | 13,100 |
| Loans and floating, etc | 15,143,000 | 17,100 | 76,000 | ..... | 15,219,000 | 4,800 | ..... | ..... | 17,014,000 | 3,200 |
| Bonus and Government aid | ..... | ..... | 10,301,000 | 4,500 | 10,301,000 | 3,300 | $58,759,000 | $42,500 | 22,012,000 | 4,200 |
| Total | $289,013,000 | $326,800 | $46,632,000 | $20,400 | $335,645,000 | $106,100 | $58,759,000 | $42,500 | $187,767,000 | $35,600 |
| Interest on bonds | 3,385,000 | ..... | 1,535,000 | ..... | 4,921,000 | ..... | ..... | ..... | 3,95 ,000 | ..... |
| Interest on loans and floating, etc | 757,000 | ..... | 4,000 | ..... | 761,000 | ..... | ..... | ..... | 851,000 | ..... |
| Apparent total fixed charge | $4,143,000 | $4,690 | $1,539,000 | $680 | $ 5,682,000 | $1,800 | ..... | ..... | $4,810,000 | $910 |
| Gross earnings | ..... | ..... | ..... | ..... | 16,091,000 | 5,090 | $3,090,000 | $ 2,240 | 9,642,000 | 1,830 |
| Working expenses | ..... | ..... | ..... | ..... | 11,094,000 | 3,510 | 3,170,000 | 2,290 | 7,168,000 | 1,370 |
| Net earnings | ..... | ..... | ..... | ..... | +$4,997,000 | $1,580 | — $ 80,000 | ..... | +$2,474,000 | $460 |
| Per cent. of working expenses to gross earnings | ..... | ..... | ..... | ..... | 69 | ..... | 103 | ..... | 74 | ..... |
| Apparent net income | ..... | ..... | ..... | ..... | — 685,000 | ..... | —80,000 | ..... | — 2,336,000 | ..... |
| Train mileage | ..... | ..... | ..... | ..... | 15,381,200 | ..... | 4,280,000 | ..... | 8,732,000 | ..... |
| Average trains per day | ..... | ..... | ..... | ..... | 6⅔ | ..... | 4 1-5 | ..... | 24 | ..... |
| Earnings per train mile | ..... | ..... | ..... | ..... | $1 05 | ..... | 73c. | ..... | $1 10 | ..... |
| Cost of train mile | ..... | ..... | ..... | ..... | 72c. | ..... | 75c. | ..... | 82c. | ..... |
| *Operating expenses—* | | | | | | | | | | |
| Maintenance | ..... | ..... | ..... | ..... | 11½ | ..... | 25 | ..... | ..... | ..... |
| Working and repair of engines | ..... | ..... | ..... | ..... | 24 | ..... | 36 | ..... | ..... | ..... |
| Working and repair of cars | ..... | ..... | ..... | ..... | 7 | 69 | 14 | 103 | ..... | ..... |
| General expenses | ..... | ..... | ..... | ..... | 26½ | ..... | 28 | ..... | ..... | ..... |

| | Main Line. | | Branches. | | Total. | |
|---|---|---|---|---|---|---|
| | Total. | Per mile. | Total | Per mile. | Total. | Per mile. |
| **CANADIAN PACIFIC RAILWAY SYSTEM.** | | | | | | |
| Miles | 3,575 | ..... | 2,709 | ..... | 6,284 | ..... |
| *Capitalization—* | | | | | | |
| Bonds | $98,923,000 | $27,700 | $47,027,000 | $17,300 | $145,950,000 | $23,200 |
| Preferred stock | 6,424,000 | 1,800 | 3,585,000 | 1,300 | 10,009,000 | 1,600 |
| Common stock | 65,000,000 | 18,200 | 12,410,000 | 4,600 | 77,410,000 | 12,300 |
| Loans and floating, etc | 1,948,000 | 500 | 3,445,000 | 1,300 | 5,393,000 | 900 |
| Bonus and Government aid | 58,996,000 | 16,500 | 17,454,000 | 6,400 | 76,451,000 | 12,200 |
| Total | $231,291,000 | $64,700 | $83,921,000 | $30,900 | $315,213,000 | $50,200 |
| Interest on bonds | 4,122,000 | ..... | 2,285,000 | ..... | 6,407,000 | ..... |
| Interest on loans and floating, etc | 97,000 | ..... | 173,000 | ..... | 270,000 | ..... |
| Apparent total fixed charge | $4,219,000 | $1,180 | $2,458,000 | $900 | $ 6,677,000 | $1,060 |
| Gross earnings | ..... | ..... | ..... | ..... | 17,962,000 | 2,860 |
| Working expenses | ..... | ..... | ..... | ..... | 11,317,000 | 1,800 |
| Net earnings | ..... | ..... | ..... | ..... | +$6,645,000 | $1,060 |
| Per cent. of working expenses to gross earnings | ..... | ..... | ..... | ..... | 63 | ..... |
| Apparent net income | ..... | ..... | ..... | ..... | — 32,000 | ..... |
| Train mileage | ..... | ..... | ..... | ..... | 12,319,500 | ..... |
| Average trains per day | ..... | ..... | ..... | ..... | 23 | ..... |
| Earnings per train mile | ..... | ..... | ..... | ..... | $1 45 | ..... |
| Cost of train mile | ..... | ..... | ..... | ..... | 91 | ..... |
| *Operating expenses—* | | | | | | |
| Maintenance | ..... | ..... | ..... | ..... | 15¾ | ..... |
| Working and repair of engines | ..... | ..... | ..... | ..... | 19 | ..... |
| Working and repair of cars | ..... | ..... | ..... | ..... | 4 | 63 |
| General expenses | ..... | ..... | ..... | ..... | 24¾ | ..... |

It is noticeable that the cost per mile of the main line, $64,000, is not as high as the average of U.S.A. railways, and the route is very rugged, while the branches containing many first-class roads in Ontario and elsewhere have only cost $30,900 per mile, and very little, if any, has been charged against the main line, as in the Grand Trunk system.

(2) *Grand Trunk Railway System.* — The main line, built in early days when wages and material were high, built too solidly for its traffic, built in disregard of what is now known to be the true principles of railway location, and since then, burdened still further to pay bond interest and buy branches, is loaded with an enormous debt. The branches were often injudiciously bought, or bought to protect its traffic at a sacrifice, and do not pay. Taking the road as a whole, it is loaded with a heavy debt; suffers from keen competition, not only from Canadian, but U. S. railways; and by being thus forced to haul at low rates, has never been able to meet its obligations in spite of a traffic of $5,090 per mile, which increases to $6,000 per mile in good years. Its operating expenses are higher, and train earnings lower than they should be, and a more vigorous management with a more careful study of maximum train loads by the tonnage system may effect improvement. This system has been the backbone of Canada; it has received very meagre aid ($3,300 per mile) from governments or municipalities, and the bondholders and owners deserve the highest praise for the integrity of management which has characterized it; a less scrupulous one would have thrown it into a receiver's hands after having plundered it for a few years. This has been done in America very often, with a severe loss to British bondholders. It is noticeable that the branches have been bought, largely, by mortgaging the main line; it is impossible to arrive at the cost of each.

(3) *Dominion Government Railways.*—These cost as much to operate as the earnings amount to. The cost per mile is a good example of actual cost, there being no inflation of capital. The Intercolonial was well built through a rough country; but could be built to-day for less than $30,000 per mile, owing to less cost of explosives, steel, labor, etc. It seems evident that for the light traffic of $2,240 per mile, there are too many trains per day; $4\frac{1}{5}$ trains per day for 365 days is too much, and although the people on the route might object, the economy of reducing traffic to about three trains per day, say one passenger, one mixed, one freight, would effect a great saving; this is evident by the very small train-mile earning, 72c.

(4) *Remaining Railways of Canada.*—These contain several high class roads, such as Canada Atlantic and Michigan Central; but on the whole, they are those roads which have been built to serve local needs or to develop country; their cost per mile ($35,500 being total capital against them) is small, but traffic still smaller; their earnings are not nearly sufficient to pay fixed charges, and some borrow more each year to pay it, while others default payment. The future of many of them is not reassuring until their traffic increases; but they are, on the other hand, many of them aiding in the development of country that would otherwise be beyond reach.

The need for more railways in Canada, except for some very special reason, is not at present apparent.

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THE Rossland, B.C., council will buy at once a chemical engine, hose wagon and hook and ladder truck.

*For* THE CANADIAN ENGINEER.

## TOWNS WATER SUPPLY AND ITS DISTRIBUTION.

BY W. M. WATSON, TORONTO.

The geographical advantages of Canada are superior to those of most countries. There is none where there are such a large number of fine sheets of water of good potable quality, and almost every town and small village could have a plentiful supply of good water, inside each house, at a moderate cost, if the Government would engage engineers and mechanics who have skill and experience, to work out a comprehensive scheme in each district. It is a crime to supply a town with tainted water, or compel those living in villages to depend on wells of doubtful purity, which sometimes run dry when water is most in demand. Abundance of good water in the house convenient for use at will is a sanitary necessity, and it is the duty of the governing body to arrange for and secure a permanent supply at a reasonable expense and charge to the consumer.

When constructing waterworks, care should be taken in arranging and joining the iron street mains and conduits and every other apparatus used for distributing or conveying the water, so that they cannot be injured by frost or dirt, or by the pounding of water hammer caused by sudden concussions of confined air. The joints should be all well and carefully made, and if lead be used, each joint should be run full and solid at one teaming of the ladle, at least to a depth of two inches. Maiden or new pig lead should always be used for jointing. Each joint should have two circles of hemp rope driven well back and tight, for the lead to wedge against. It is the hemp rope that keeps the joint tight; the lead holds it to its place, so it is necessary to have a good quality of rope. Above all else, it is necessary to make proper provision for cleaning out every part of the pipe system, and to prevent waste or leakages, which not only wastes money, but damages the roadbeds and the foundations of property adjoining the line of pipes.

Water suitable for domestic use should be transparent, without smell, taste, or suspended matters, totally free from any excreta or sewage deposits of any kind. Marsh or nullah water, which is loaded with vegetable debris, must be carefully avoided. Water for industrial purposes should be void of minerals, because they increase the cost of soap and scouring materials when used for cleaning purposes, they scale steam boilers and heating pipes, and interfere with the production of colors when dyeing fabrics. The French cloths are always softer to the touch than British, because of the quality of water used in finishing and dyeing, and thousands of pieces of manufactured stuffs are sent over to France from England to be dyed and finished and then returned. Tainted dirty water with a mixture of fine sand would ruin a stuff manufacturer or dyer in a short time. It is advantageous to secure water well ærated, similar to the water at the foot of Niagara Falls, or rain water, which during its fall through the atmosphere secures (according to analysis made by Dr. E. A. Parks, F.R.S.), a large percentage of oxygen.

D. G. F. Gaskins, C.E., when delivering his presidential address before the British Association of Waterworks Engineers at Nottingham last year, stated that to manage a waterworks a knowledge was demanded which could only be obtained by close study, application and practice. This is different teaching to that of a promi-

nent civil engineer, who wrote to me saying that there was no room in Canada for experienced waterworks superintendents, because the colleges were turning out yearly more students than there were such places to fill. If the students fill such positions raw from the colleges, without learning the trade and securing working experience, whatever salary or wages they receive, it is little better than robbery of the ratepayers. A valuable engineer never attempts to construct, or even manage the construction of systems that have been planned and laid out from his own ideas. He keeps his position, and expects the mechanic and manager to faithfully keep his.

Mr. Mansergh, in his fifteen-thousand dollar report on Toronto waterworks, expressed himself in a way that can only be interpreted to mean that he considered the construction and management of all American waterworks systems of a low standard. He attributed the reason to the fact that the city of Toronto had to pump over 100 gallons of water for each inhabitant each day, to waste or misuse—adding the important remark, as in other American cities. (See copy of report in the *Surveyors' Journal.*) The reason why there is a low standard of public works in this country in comparison to the works in the old country, is because there is no proper check placed on the local authorities by the Government. A single ratepayer having a substantial grievance and who can prove that the local authorities are wasting public money, or mismanaging the public business, or allowing the public works to be mismanaged, or voting themselves funds, etc., can petition the English Local Government Board, who will send an expert engineer to make a full inquiry, and if abuse of the trust put in the representatives elected by the popular vote be proved, or it is found that any of the officials are not worthy of the confidence placed in them, he will report the same to the Government, who will take measures to correct the evil.

I was appointed to investigate a waterworks on which there had been an inquiry of this kind, and I proved that most of the wealthiest manufacturers were daily stealing large amounts of water, and that less than half the amount of water provided by the ratepayers of the town was paid or accounted for. The result of the Government interference in this case was a saving to the public taxes of about $30,000 each year afterwards.

Mr. Griffith, C.E., states that under proper management the advantages of local authorities owning their own waterworks are as follows:—

1. A local authority elected by residents in the districts has a greater personal interest in the matter of supply, and is better qualified to administer the undertaking in their own interest than a private company, whose only object is profits.

2. A local authority need not make any profit out of the supply. They can also borrow capital for construction of the works cheaper than a private firm and reduce the charges for supply to consumers accordingly.

3. Public sentiment is always in favor of having such a universal necessary of life and health in their own hands.

The chief difficulties against public ownership are:

1. The periodical changes of council, and sometimes even the constitution, which often interferes with the continuity of a policy.

2. The liability of the works being handled by men appointed through society, family or political influences, in place of having skilled mechanics and experts.

3. The habit, which is sometimes allowed or blindly ignored, of selling favors and accepting perquisites, which often is the cause of scamp work being done, and of public works costing more than similar works done by private business firms, or such well conducted councils as Glasgow.

The revenue from the sale of water in Toronto is stated in the newspapers to be $445,000; taking the population at the highest stated number, viz., 190,000, it runs about $2.30 per head; an average for each house of five inmates of $11.50. They say we owe on account of the waterworks $3,817,287.32, or an average per head of $20.09. Had the Toronto waterworks been constructed and managed by a business firm with the ability of the T. Eaton Co., for example, it would not have cost half, and the charge to consumers could have been proportionately less.

There cannot be a great difference between the need for water in European and Canadian towns which have similar conditions, only that English towns use a great percentage of their water in supplying cheap public swimming baths of large dimensions. The difference in consumption has no connection with the fact that the heat or cold is more excessive, because the returns given us of the water pumped in Toronto in the months of April and November, when there is no garden or street watering, public water fountains, no frost needing taps to be kept running, nor anything at all different to any British town, gives only a little different figures to those published for any of the other ten months.

Mr. Palmer, C.E., states that the Malvern authorities supply each water consumer with a meter, and the average consumption is 5½ gallons per head per day. I know several small towns that do not use meters which use less than 6 gallons of water for household purposes per head per day. The total quantity of water used for all purposes in the town of Nottingham, with a population of 250,843 last year, was stated to be under 21½ gallons per head per day. In Bradford, a town of 240,000 inhabitants, they used 26 gallons per head through meter for manufacturing purposes, and about 27 for all other purposes, including several large swimming baths. Mr. Bateman states that he tested a group of 14 towns in England, and found the average consumption for all purposes was 24 gallons, and in a single group of working class houses, containing 82 inmates, the average consumption per day per head was 7½ gallons. I myself tested a house in Toronto by having a new Siemens water meter fixed on for five years. The house had eleven inmates, two baths, one basin, w.c., hot water and range boilers, hose pipe, stable and horse. The average amount of water taken each year was under 28,000 gallons, less than 7 gallons per head per day.

The Toronto *Star*, on May 1st, stated that only 198,000,000 gallons of water were sold to manufacturers in a year in Toronto, or under three gallons per head, leaving about 100 gallons per head per day for sanitary and domestic consumption, or 75 gallons over the consumption of similar British towns. If Toronto were situated in England, there would be a government inquiry into the cause of this waste. Returning again to the mechanical and engineering side of the subject, as I have before stated, the best water for public use is rain water collected from clean land, because it cannot possibly be contaminated by mineral, manurial or sewage deposits. Taking a supply from a river near its source, or from an elevated lake, is often as good as collecting rain water. When taken from a

river, the mouth of the suction pipe should face the way the water flows, because by so doing the best water will be drawn in, while the floating impurities will pass forward with the current. When from a lake, it should face downward for the same reasons. Taking water from a lower level than the town is built on is often injudicious, because it may be fouled by the sewage from the population living within the watershed, which sometimes contains an area of several thousand square miles, and should the population be small at present, and the impurities from the sewage imperceptible, it may soon alter. All large towns should have forethought sufficient to arrange for a good permanent supply while the opportunity serves. To depend on a supply by pumping and long suction conduits is risky and expensive, and it is probably cheaper to carry a supply fifty miles and have a proper gravitation system. (1) Because the source of supply being necessarily at a higher elevation than a pumping source, it is less liable to be contaminated. (2) Though the first cost of works may be more on account of the long length of trunk mains which might have to be conveyed through tunnels and across ravines on viaducts, yet the annual expenses of pumping in wages, repairs, renewals, etc., will probably amount to more than would pay the interest on the capital expended on a comprehensive, well engineered scheme. Such a plant would be safe and permanent, besides free from contamination, because by making judicious arrangements to supply the villages located on the route of the pipe, by measure, sufficient revenue might be collected to pay the interest on the cost of running the trunk pipe through their section of territory.

When it is necessary to store water in reservoirs so that the supply can be abundant when the rainfall is least, such reservoirs should be carefully covered over and ventilated. In form they should be deep rather than extended, so as to lessen the evaporation, to keep the water cool and at an even temperature as far as possible all the year round, to prevent the water from absorbing the impure gases from the atmosphere, and prevent the sun's rays from increasing the microbes and bacteria. When large natural reservoirs are made in the hills they must necessarily be open, and the face of the water exposed to the sun and air; such water should be passed through a good, clean filter immediately before entering the supply pipes. In fact all water, however collected and stored, should be filtered.

It is a fact that the purer and softer the water is the easier it is to contaminate. It will attract and absorb minerals and poisonous gases with a wolfish appetite. At Harrogate in England there are eleven springs of water, each loaded with different minerals and chemicals, which each stream has taken up on its passage through the earth from the seat of the rainfall to the springs.

Then another example: Six families living in good, airy, isolated houses, went on their holidays for a few weeks to the seaside. A short time after each family returned home some of its members were taken ill with typhoid fever. Being superintendent of the water supply, it was my duty to investigate so remarkable an occurrence, and found that the owner had broken the laws of water distribution by allowing his tenants to take the whole of their water supply from a large shallow open cistern hidden in the false roof that was open from end to end over all the sleeping rooms of the six houses, and that the loft had no ventilation whatsoever; so that all the poison contained in the atmosphere of the sleeping rooms passed through the porous plastered ceiling, and having no other means of escape was absorbed by the sheet of water in the cistern, and the water became poisoned before being used by the inmates. A French writer, has indeed proved that the human system can be trained to receive large doses of poison without serious injury. If his theory was incorrect, how could so many people live in a poisoned atmosphere, yet have general good health. The trouble with this group of families was that they had lived at another place for a time and broken the continuity of the doses, and when they returned home and began to take them up again on a healthy, well-ordered constitution, the sudden start upset them. The water would be worse than usual on account of a small quantity only having been used during the time of absence. I have related this at length to show the great importance of covering fresh water tanks and reservoirs, and the advisability of erecting them in places sufficiently removed from any chance of contamination.

With the object of removing dirt from the lower points of street water mains, some engineers connect the ends of the pipes together and form a circuit of water down one street and up another. The method does not remove the evil, but distributes over a larger area the dirt or polluted water in the pipes. I believe the circulating policy is adopted in Toronto, for I am sometimes engaged to remove fish and other obstructions from taps and valves. I also notice if a bath full of fresh water stands for a few days, there is a sediment at the bottom. Then water taps and other waterworks appliances only keep in good condition about a quarter as long as at places where the water is free from fine sand and grit. The cost of repairs and renewals on account of fittings being injured by the grit must amount to a large sum throughout the whole city. I once witnessed water flowing from a branch pipe from which a fire hydrant had been removed run black for about fifteen minutes, leaving a large quantity of gritty deposits on the ground, and at another time a six-inch water main that had been taken out on account of a defect, had about one inch of black and green sludge adhering to the lower side.

The dirt could not lie in that position, nor the water get so far polluted as to run dirt for so long a time, if reasonable provision were made to clean out the pipes and suction conduit, and the conduit were laid in such a mechanical way that the joints could be kept permanently water tight. I don't see how they can be kept tight during the alteration of the temperature of the water they lie in, if the sketch shown in the *Telegram* newspaper be correct and reliable. The proper way in my opinion to lay down distribution water mains for a town is to lay the large carrying mains along the roads having the highest elevation, and take out branches commencing with a cut-off valve and air ball, then continue them down along the streets to the lowest points of each street or section of streets, and on the terminating end of each branch pipe affix a full-sized sluice valve about ten yards beyond the last service pipe. Round the sluice valve build a well or valve chamber with a gully trap and drain pipe twice as large as the water pipe, and construct the bottom one foot below the valve. Solids and impurities of all kinds contained in water mains that are under pressure are always forced to the lowest points, and can be easily removed by opening the terminating valves, about once a month or oftener, according to the quality of the water, for about one half minute.

Water mains should be as carefully graded as gas or sewer pipes, and have air balls of the self-acting kind (Fig. 1) fixed at all the highest points, and full-

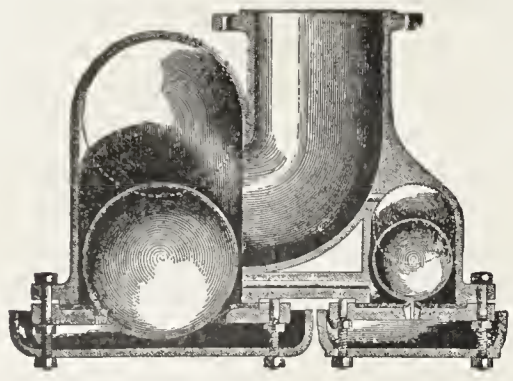


FIG. 1.

sized sluice valves at all the lowest points and dips, so that the whole system may be emptied and cleaned when necessary, and freed from deposits of grit and slime.

It must be remembered that water will run through water without moving the water adhering to the sides of the pipe it is passing through, and if the mains are larger than is needed to pass the supply taken from them, and the water is soft and pure, the motionless water clinging to the sides will set up an action with the metal and become hardened and turn into a brown calcareous matter, and continue to grow and diminish the bore of the pipe until there is just sufficient room to pass the necessary stream, when it will stop and continue in that shape for any length of time. For example, I inspected a fire hydrant intended to protect an isolated hall in a corner of a town, and found that it would not deliver any more water than the common bib water tap on the kitchen sink. On cutting the three-inch main to find the cause, I found it calcarized and the bore reduced as above stated, and the whole of that branch line for about one half mile had to be relaid with new pipes. Had the terminating sluice valve been open full wide once a month, and the dead water clinging to the sides of the pipe let out, along with any calcareous scales that might have started to form, it would never have been necessary to relay, and the hall would not have been in jeopardy for several years.

A 30-inch earthen pipe having cemented joints, that carried water from one storage reservoir to another on the moor land, got its bore diminished by fine rootlets passing through the cracks in the cement joints, growing inside and choking the interior. The calcareous matter growing on the inside of water mains can be removed by a machine called a ferret, which is so constructed that the pressure of water turned on behind it will force it through a moderate length of water pipe, and during its passage it will scrape the inside clean. When this method is used, clean-out doors must be provided at short intervals.

Neither large nor small water filters are of any use except proper provision is made for cleaning them easily, because no matter what material is used for a filtrate there is a limit to its usefulness. The best filters are made from either animal charcoal well pressed together, so that the water must pass through the coal, or magnetic carbide of iron. For purifying fresh water that is void of sewage deposits, about 15 inches of fine washed, clean, sharp sand and 20 inches of gravel will make a suitable filter, if the top layer is removed and clean washed; then spread on again about once each week. This will make the water of a bright color and pure. If I were to build a filter on a large scale I should have a graded concrete bottom, so that the water on escaping from the filtrate material would come together and form a stream to enter the distribution pipes. I would then have a false grated bottom, bearing on pillars, to hold the filtrate material. I would run the water to be treated over shallow troughs, the bottoms pierced with very fine holes at a convenient elevation above the filter, so that all the water intended to be filtered would fall into the filter in a fine spray similar to a needle bath; falling a distance say of four feet, in the form of a fine spray, the water would be aerated. I would also make a good system of ventilation that would insure a strong current of air to be continually passing between the cemented and false grating floor at the bottom of the filter. The water should pass slowly through at a pressure of about two feet above the face of the sand.

When water is delivered to consumers the shut-off tap usually fixed in the sidewalk near the street line should be of the screw-down pattern with the valve working loose inside, so that when full open it would allow water to pass through towards the house, but it would not allow any to return back into the mains. The tap would have a double action; it would not only make a first-class stop tap, but also a foot or check valve. (See sketch of the loose valve inside the bib tap shown.) This would prevent any fluid being forced or

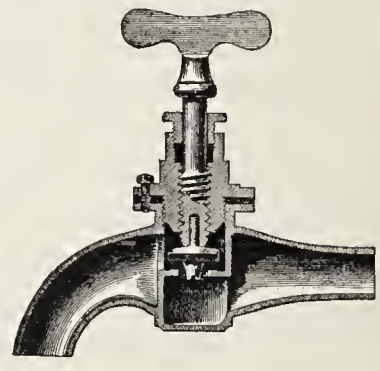


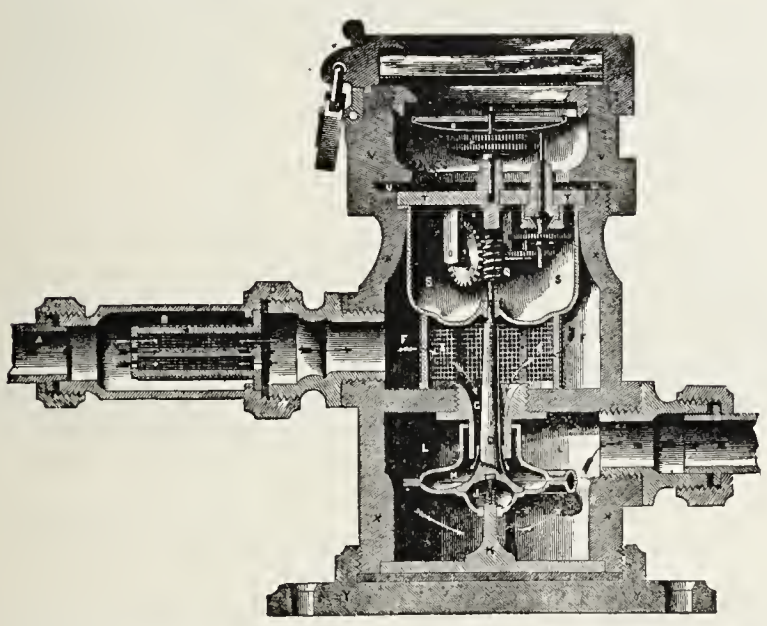
FIG. 2.

drawn into the street mains, and effectually prevent the return of hot and tainted water from water-heating boilers, steam and range boilers, etc., which is at present very prevalent.

Lead water pipes when laid in the earth should not be near any metal, because a galvanic action will be produced; nor near an electric car line, for the electricity will damage the lead if the soil it lies in is damp and a good electric conductor. Nor should it be laid near any tile or other drain, because a leakage of water would find a downward way of escape, and could not be easily found; nor under any manure pipe, or near dirt or filth of any kind, because when the water is motionless in the pipe it will absorb some of the foul gas thrown off from such filth through the lead coating, and become tainted. Lead is the handiest metal for small water pipes, because it can be easily bent to any angle. When damaged by frost or water hammer it is easy to repair without removal. When laid underground it will sink with the soil, stretch, or give and take a little without injury. On the other hand, when rigid iron is used it will break before bending, and if damaged a full length has to come out. It is very unfortunate that a chemical action sets up between pure soft water and lead, which poisons the water when it stands motionless in the pipe for a few hours, and thousands have been seriously injured in health by drinking and cooking with water poisoned in that way. The water that poisoned the Louis Philip family of Claremont contained seven-sixteenths of a grain of lead per gallon, and the water taken from the same source had injured to various degrees thirty-four per cent. of

the population of the town. Analysts differ as to whether water can be poisoned by passing through galvanized or zinc pipes or not. I am positive that distilled water can be injured by using galvanized vessels, and if so other water must be injured to a less degree. Black iron, specially made very strong and soft in nature, so that it can be bent easily, is the healthiest article for use for service pipes. Some of the means suggested for removing the evil and still using lead pipes for domestic water supply, are: 1. To line the lead pipe one-sixteenth of an inch thick with block tin; 2. To give the pipes a bituminous coating; 3. To boil the lead pipe before using in a strong solution of sulphur and soda.

As a superintendent of waterworks, I have had the responsibility and care of many Siemens and Adams water meters, which are used largely because they are light and handy to fix. They are simple in construction, measuring the water by forcing it through a turbine or baker's wheel very similar to garden sprinklers that spin round when delivering the water. The act of the turbine turning round moves the dials and registers the quantity. I have never seen large meters of this kind in use. A meter to insure accuracy for a long period must measure the water by loading and unloading a vessel similar to a dry gas meter. When the Siemens pattern and all similar meters become worn, or the inside gets thickly coated with scale or dirt, the water will pass through unregistered, and they can also be easily tampered with. I here show a sketch and give the manufacturer's own description.



This meter is constructed upon the well known principle of Barker's mill The measuring medium consists of a drum, working on an upright spindle at the bottom, and in a collar at the top. The water is conveyed by the conducting tube into the centre of the drum, and allowed to escape at three or more apertures on the periphery of the same, giving to it a rotary motion. At each revolution of the drum a certain number of cubic inches of water is delivered, so that it is only necessary to register the number of revolutions to ascertain the quantity; this is effected by wheels and pinions, and the result indicated in gallons or feet, upon a graduated dial.

In conclusion, I may say that when the steel conduit was about being laid down across Toronto bay, I suggested, in a letter to the *Globe*, printed January 18th, 1888, that a subway should be made from the north side of the railway tracks to the nearest point of the Island, large enough for a car track, a carriage-way and two sidewalks for foot passengers; that the sidewalks should be raised similar to the long subway at Montreal, and that two conduits, one under each sidewalk, should be laid on blocks or rollers so that the tube could be easily inspected; after leaving the subway the two conduits should be joined and conveyed across the Island to the intake, trenched into the ground. Until something in this way be done to make Toronto supply from Lake Ontario a safe and permanent source, free from the contaminating influence of the filthy bay water, the supply will remain risky and polluted when the conduit leaks, or is loaded with sand.

## ELECTRICITY IN RAISING OIL.

An interesting and highly successful experiment has been carried out at Petrolia by W. H. Ashworth, manager and electrician of the Electric Light Company of that town, in applying electricity to the pumping of oil. Out of the 8,000 oil wells, which yielded about 800,000 barrels in Canada last year, there are nearly 6,000 in and around Petrolia. One would think that in a town like Petrolia, where they have "oil to burn," so to speak, they would use some kind of crude oil engine, or at least use oil as fuel for the steam engines that are required on the fields. But they do neither. They use steam engines to work the pumps that lift the crude oil, and they use wood and coal for fuel for these engines. As those acquainted with the petroleum business know, the wells are bored in all directions about the town, many of them in the back yards of the owners' houses; so that the visitor on approaching the town sees a forest of derricks, looking like the stumps of trees left after a fire has passed through a green forest. Under each derrick is a well, worked either by a "walking beam" or a "kicker"—that is, two arms joined at right angles, one arm slanting vertically, the other horizontally, the latter having the pump rod attached to its outer end. A group or "batch" of these wells are operated from one engine, rods and scantlings being connected from the engines to the kickers and walking beams. The wells run by one engine are at all kinds of angles to each other, this being easily accomplished by a crude horizontal wheel, making a quarter turn and back, and so pushing and pulling the rods of the pumps on its line. By putting a wheel whenever a well has to be reached at an angle, a dozen or even thirty wells may be reached from a single engine. Mr. Ashworth last July undertook to operate a "batch" of wells from the dynamo in the Petrolia Electric Light Co.'s power house, and installed a six K. W. 500-volt Canadian general machine in a small building in the field beside one of the old engine houses. The little shed required for the purpose was only half the size of the steam power house, and no heavy foundation or boiler setting was required. The machine was placed on a frame consisting of two pieces of 10" by 10" timber on each side, one on top of the other, to give a clearance from the ground for the driving gear, which was a set of pulleys belted so as to reduce the motion imparted from a main shaft operating a crank at either end, the two cranks being placed so as to give an alternate motion to the two sets of pump rods; this simple apparatus was attached to 16 very heavy wells known as "water wells," and running at much higher than the usual speed, but they have been run most successfully by electricity ever since. No boy or man is required for firing, and the machine requires no attention after it is started each day. Last year in Ohio or Pennsylvania one or two wells were experimentally operated by electricity, there being a separate dynamo for each well, but this, we believe, is the first case on record when a "batch" of wells has been electrically operated.

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James Lydiatt, formerly of the Wallaceburg, Ont., Glass Works, proposes to start a glass factory in London, Ont., which has the necessary sand near as well as superior railway facilities. The city is of course expected to assist the project.

## THE LACHINE RAPIDS POWER PLANT, MONTREAL.*

BY WM. I. BISHOP, MONTREAL.

The problem of utilizing the power of the St. Lawrence River at Lachine Rapids, near Montreal, is one which has for many years engaged the attention of engineers and capitalists. Their almost unanimous opinion has been, however, that although considerable power could be obtained during the summer months, the drowning of the rapids during high water would so reduce this that any scheme requiring continuous power the whole year round would not be feasible. Support was given to this idea by facts observed during the running of a small grist mill erected on the site, for which power was obtained by throwing out a small wing dam. This mill was compelled to shut down during a part of the winter, owing to back water. Another serious objection was that great quantities of frazil or anchor ice run through the rapids almost all winter, and it was thought impossible to prevent its filling up the head race and wheels.

About five years ago Messrs. T. Pringle & Son and W. McLea Wallbank, of Montreal, after a careful study of the question, came to the conclusion (which has been proved since the river bed has been laid bare) that the backing up of the water and drowning of the rapids was caused by the great bars of rock which rise out of the river bed at an acute angle, facilitating the collection of frazil and the formation of natural ice dams.

The Lachine Rapids are probably the most famous of the series of rapids along the St. Lawrence River from Lake Ontario to Montreal. Every one who has ever taken the steamer trip down them, which is one of the most enjoyable experiences of every pleasure-seeker's visit to that city, will recall the rock barriers, which make their presence manifest to the practiced eye by the turmoil of the waters, even when wholly submerged.

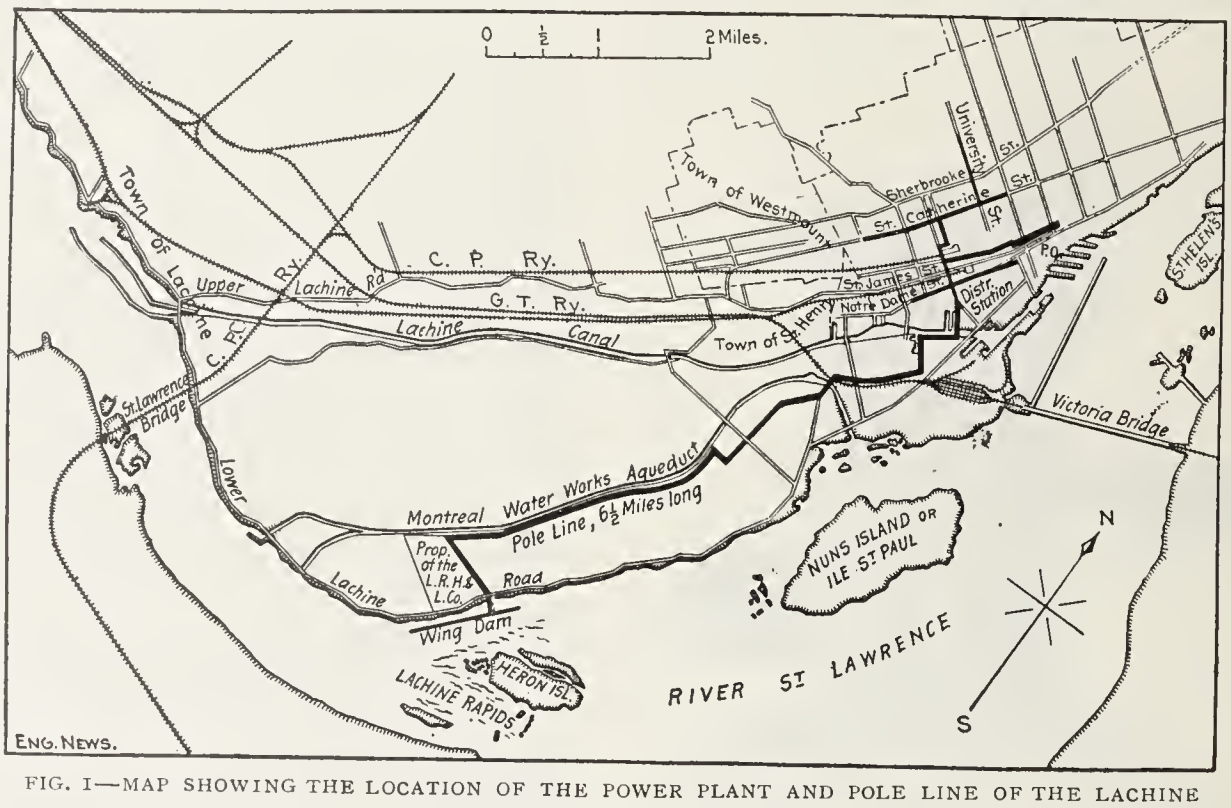



FIG. 1—MAP SHOWING THE LOCATION OF THE POWER PLANT AND POLE LINE OF THE LACHINE RAPIDS HYDRAULIC AND LAND CO.

Above the rapids the river widens into a broad expanse, known as Lake St. Louis, some six miles wide and 14 miles long. The rapids themselves are about five miles in length, and their total fall is about 30 feet. Briefly stated, the plan for power development which is being carried out by the Lachine Rapids Hydraulic & Land Co., is to project a dam into the stream at a point about one mile above the foot of the rapids, and by a dike parallel to the river bank and extending up stream 5,000 feet from the river end of this dam, to make a broad head race, which will take water from a point where the water on the rapids is about 11 ft. higher than the dam. Below the dam there is a further fall of about 10 ft. in a distance of about a mile to the foot of the rapids.

The works are designed to utilize 15,000 cubic feet of water per second, which will be about 10 per cent. of the entire flow of the river at low water.

The general map of the rapids shown gives a good idea of the location of the company's power plant with reference to the rapids and the city of Montreal.

### GENERAL DESCRIPTION OF WORKS.

By reference to the general plan (Fig. 2) it will be noted that the present scheme, as now being carried out, will consist of: (1) A head race 3,705 feet long, formed by a wing dam composed of a 40-foot masonry ice breaker at the entrance, 3,305 feet of overflow cribwork, and 360 feet of cribwork carried up square to the same level as the top of the piers of the main dam. (2) A main dam of 43 masonry piers on concrete foundations, the piers being 4 feet thick and 17 feet high above the level of the floor of the flumes and the top of the foundation. The piers form 36 flumes, three waste weirs, and the foundations for three power houses. (3) A guard dam forming the tail race, consisting of 300 feet of cribwork 10 feet wide and 900 feet of embankment formed of rock taken from excavations. (4) A system of booms and cribwork piers designed to keep the wheels clear of floating ice, driftwood, grass, etc.

The head race is to be excavated to a depth of 12 feet below the top of the overflow dam, and is at the narrowest point near the entrance 525 feet wide, with a sectional area of 6,300 square feet, so that, allowing a discharge of 200 cubic feet per second from each wheel, or a total of 14,400 cubic feet for 72 wheels, the velocity of flow past this point will amount to about 2.3 feet per second. As the head race widens out to nearly 1,000 feet at the flumes, this velocity will, of course, be much reduced, so that there will be little, if any, lost head due to an excessive speed of current.

The current in the river just above the entrance to the head race runs at the rate of about six miles per hour, and this striking a body of water moving at the rate of only two-thirds mile per hour will give it a tendency to strike almost directly outwards, carrying with it most of the frazil, driftwood, etc., that it may contain. It is also a fact that the current has always had a tendency to strike outwards at this point, owing to a curve in the river bank just above the head-race entrance.

The water in the head race will freeze over completely in winter; and, as is well known, no frazil will form under the ice; but should any commence running before the ice forms, the racks are so hinged and arranged that they can be lowered to the bottom, or taken out completely, allowing it to run through the wheels. The crib piers and booms are so arranged that there will be no danger of the ice shoving down on to and destroying the racks. The greater part of whatever ice forms in the head race will go over the overflow dam, and the small balance will go through the waste weirs without trouble.

### CONSTRUCTION OF FALSE DAMS.

Work was commenced in the fall of 1895 by throwing out a false dam (Figs. 2, 3 and 4) of stone and earth at right angles to the shore; then by running a short wing dam down stream, enough of the river bed was made bare (Fig. 5) to enable the contractors to get sufficient stone by excavation to grade to continue the dam further out into the river, and to commence running a wing dam down to the site of the main dam, on which are the wheel houses. Every foot added to the wing dam down stream, laid more of the river bed bare and allowed excavation to be made down to grade. This work was carried on during most of the winter by means of steam drills, and the rock taken out was used to construct another dam (Fig. 2) at right angles to the shore, 150 feet above the extreme upper end of the proposed wing dams. These two false dams were connected during the past season, and when they were sufficiently advanced an opening was made in the lower dam and the water in the upper portion drained out, enabling the whole of the work to be done on a comparatively dry river bed.

* From the *Engineering News*, New York.

Much trouble was experienced in building these dams, owing to the raging current which at several places swept away 75 per cent. of the material, consisting of large boulders, etc., as fast as it was dumped in. The fact of their having been built of such large stones has also given the dams a tendency to leak badly, in spite of banking with earth mixed with pea-straw, etc.

CRIBWORK.

The cribwork dams were then commenced. These consist of, first, a high crib 360 feet long (Fig. 6) built of 12 x 12-inch face timbers laid to 2-inch joints with 8-inch flatted ties laid 8 feet apart in each course and 8-inch longitudinals; and, second, 3,305 feet of overflow crib with 12 x 12-inch longitudinals and purlines. The top is hipped up with an easy slope on the shore side and covered with 2-inch plank and 8-inch tamarac split poles with the bark on. The slope on the side towards the river is steeper, and is covered with 8-inch tamarac squared on three sides and laid on purlines. The vertical face of the whole dam on the shore side is sheeted with two layers of 2-inch plank and an ample talus of gravel is laid along the shore side. Both cribs are filled with carefully placed stone of moderate size, and are scribed and bolted to the rock when above the grade adopted for the bottom of the head race, 12 feet below the top of the main dam. Below this it is considered that the stone filling is ample security, and the cribwork is merely scribed to fit closely to the rock. The wing dam cribwork, above the main dam, is 20 feet wide at the bottom, and the cross ties are run entirely through wherever possible.

The masonry ice breaker at the upper end of the wing dam is 40 feet long and 20 feet wide; it is built on a concrete foundation two-thirds the depth of the water (which is 21 feet deep at this point), of rough bush-hammered masonry. The top is bevelled to 5 feet below the water line, and 1½-inch chains are imbedded in the concrete to fasten the upper boom.

piers. The piers are 4 feet thick by 48 feet long, 21 feet 6 inches c. to c. for both flumes and waste weirs.

POWER HOUSES (FIG. 9)

The power house walls are built in a similar manner, and contain between them massive concrete foundations for the generators. The walls are four feet thick along the front and sides to the line of the down-stream end of the piers; beyond this the masonry is only 3 feet thick and 3 feet high, with a 16-inch brick wall up to the top of the piers.

The generator foundations are constructed in the form of heavy columns with arches between, and afford every facility for getting at the holding down bolts of the generators.

Vacant spaces between and behind the foundations are filled with stone flushed over with eight inches of concrete up to the same level as the flume floors or tail water. These spaces will be utilized for heating apparatus, storage, etc., and will be accessible by a spiral staircase and a hatchway 4 x 5 feet.

SHORE ABUTMENT.

The shore abutment (Fig. 15) is also built of masonry four feet thick, and from the line of the rack runs into the bank in a sloping direction. This sloping portion is backed with three feet of clay puddle up to the frost line, four feet below the ground level. There is also a wing wall 12 feet behind this of concrete, three feet thick, running 23 feet into the bank.

The portion of the abutment next the flume is backed with concrete four feet thick, running up six feet above the flume floor, and with clay puddle three feet thick above this up to the frost line. These precautions are taken to preclude any possibility of leakage around the back of the abutments.

A cribwork embankment is carried along the shore from the corner of the abutment to a point about 50 feet up-stream. All ties in this crib are kept so that the ends will be below the frost line.

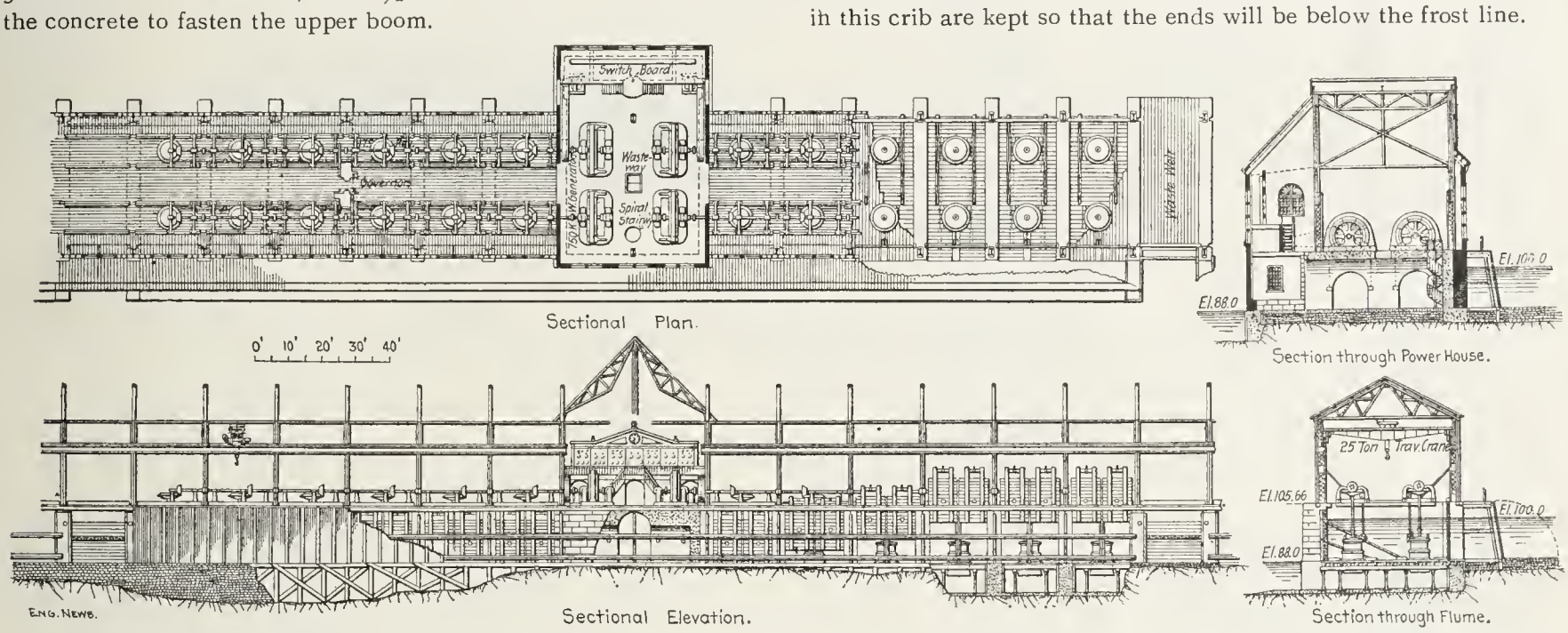



FIG. 9—DIVISIONS THREE AND FOUR OF MAIN DAM, SHOWING PLAN, ELEVATION AND SECTION OF POWER HOUSE AND TURBINE SETTINGS.

MAIN DAM.

The main dam piers (Fig. 7) are built of rough bush-hammered masonry 4 feet thick, laid on a concrete foundation 4 feet 6 inches thick, which runs up to the level of the flume floor. The rock under the wheel pits was first excavated and levelled off, and owing to its shaly and unreliable nature a layer of concrete 1 foot thick, composed of 2 parts sand, 1 part Portland cement, and 6 parts stone (these proportions were used throughout the work), was laid over it, holes being left to receive the columns supporting the flume bottoms. Caissons (Fig. 8) of 2 x 4-inch stuff, laid on the flat and well tied through, were then run up to the level of the underside of the timbers supporting the flume floor. These timbers of 12 x 15-inch pine were then laid, running back 15 inches into the concrete, and were bevelled off so as not to weaken the foundation.

The caissons were brought up to the level of the flume floor and filled with concrete. Two longitudinals of 10 x 12-inch British Columbia fir were run under the floor timbers and 15 inches into the caissons along the front of the flume. These are each supported by six 6-inch I-beam columns placed in holes in the wheel pit bottom above mentioned, which were then flushed up. Masonry was then laid on this foundation to a height of 17 feet above the flume floor. This masonry is of a very high class character, the blocks being extremely large and averaging about 2 feet in thickness; they are laid in cement mortar, composed of 2 parts of sand to 1 of cement.

Two recesses, 12 x 8 inches, 36 feet apart, are provided for the gates and stop logs, the down-stream one being 6 feet from the back of the piers, and the up-stream one being 4 feet from the front of the

WASTE WEIRS (FIG. 10).

The floor timbers and flooring for the waste weirs are finished in the same way as the flumes; 12 x 12-inch stop logs are laid in the up-stream check, and the upper four of these can be taken out and replaced to suit the level of the head water. A heavy timber slide is built over the floor for ice, etc.

Arrangements were made to drain the water through the waste weirs under the flooring during construction. This was done by omitting the concrete wall along the front from the rock bottom up, and by placing slides into which one set of 12 x 12 stop logs, and one set of 2 x 4 stop logs will be dropped and the space between filled with concrete, when the construction is completed.

HEAD GATES.

Each flume is provided with a set of two head gates of pine, 5 inches thick, for a height of 5 feet, and 4 inches thick above, with an iron sliding filling gate in each, and two 8 x 4 inch uprights with a cross piece between fitted with wrought-iron shackle to raise the gates by. The head gates move in slides fitted into the check in the masonry and fastened to an upright in the centre of the flume consisting of a 15-inch I-beam and an 8-inch channel into which a strip of wood is fitted, and to this the distance piece between the two gates is screwed. This upright is braced just at the water line by a 20 inch I-beam running across the flume and 11 inches into the wall on each side; it is securely fastened at the bottom to an iron plate nine feet long, two feet wide and half-inch thick, rag-spiked to the floor timbers.

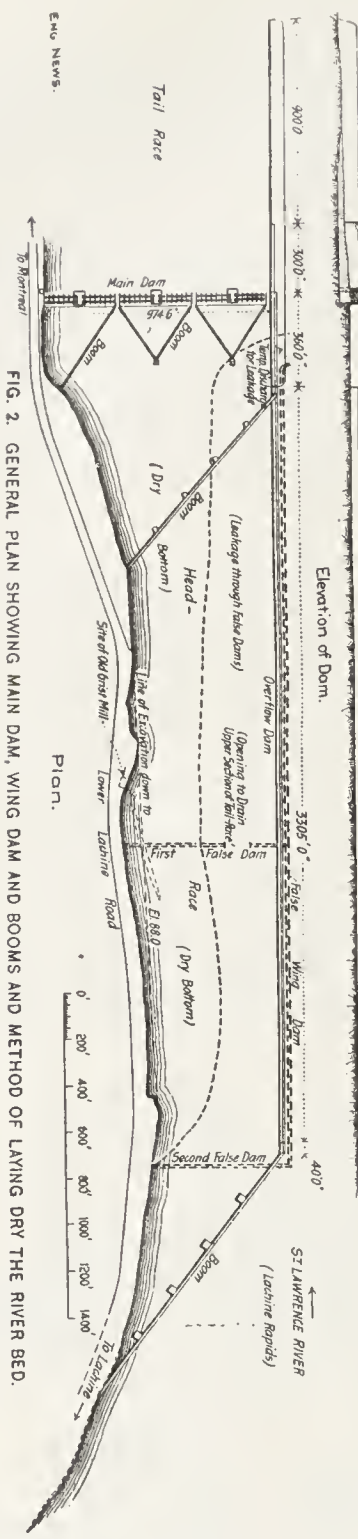



FIG. 2. GENERAL PLAN SHOWING MAIN DAM, WING DAM AND BOOMS AND METHOD OF LAYING DRY THE RIVER BED.

WATER POWER PLANT AT THE LACHINE RAPIDS, MONTREAL, CAN.

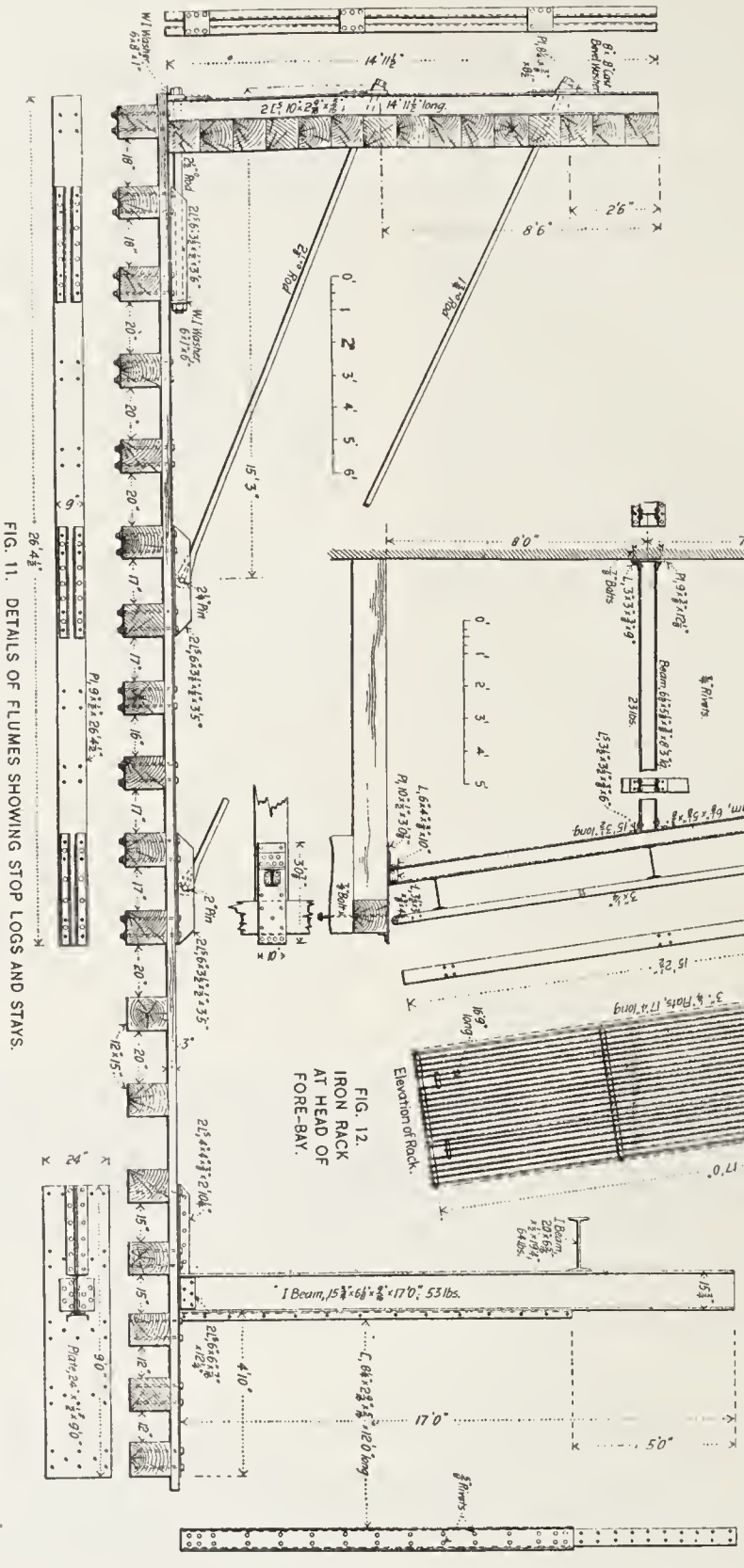



FIG. 11. DETAILS OF FLUMES SHOWING STOP LOGS AND STAYS.

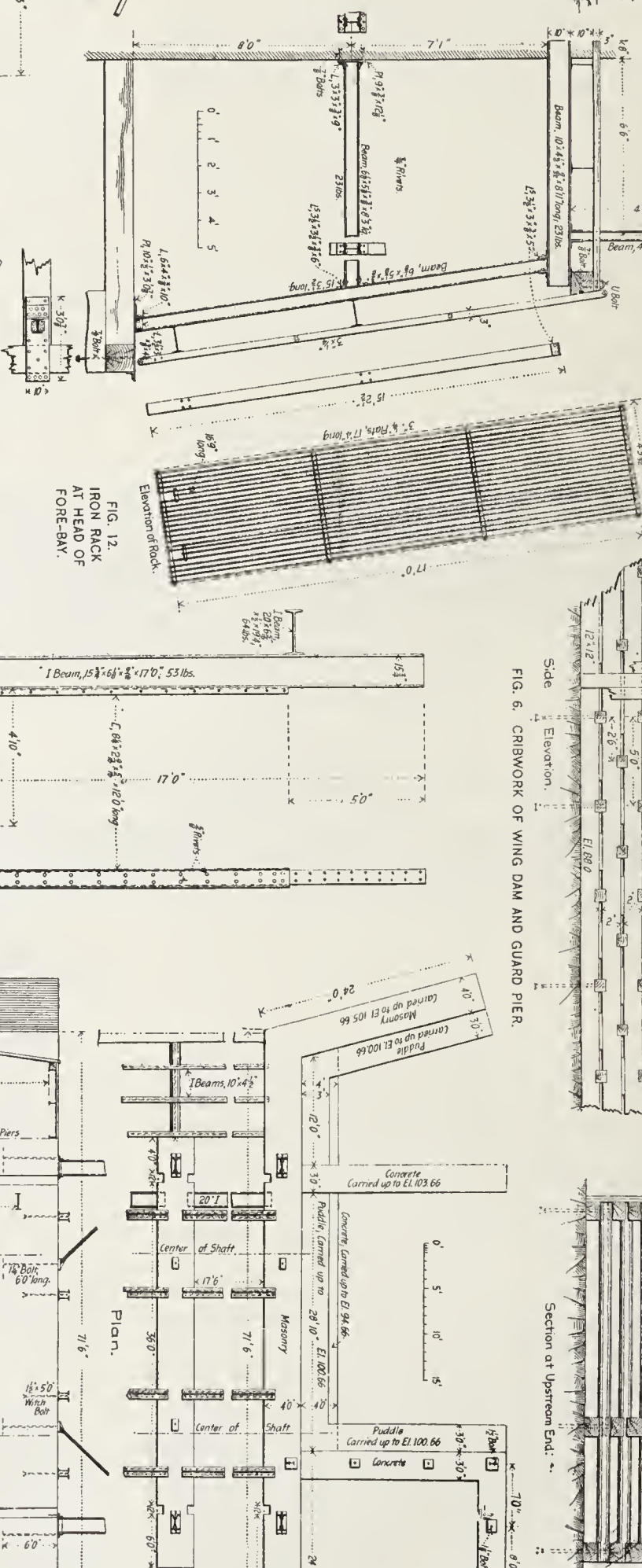



FIG. 12. IRON RACK AT HEAD OF FORE-BAY.

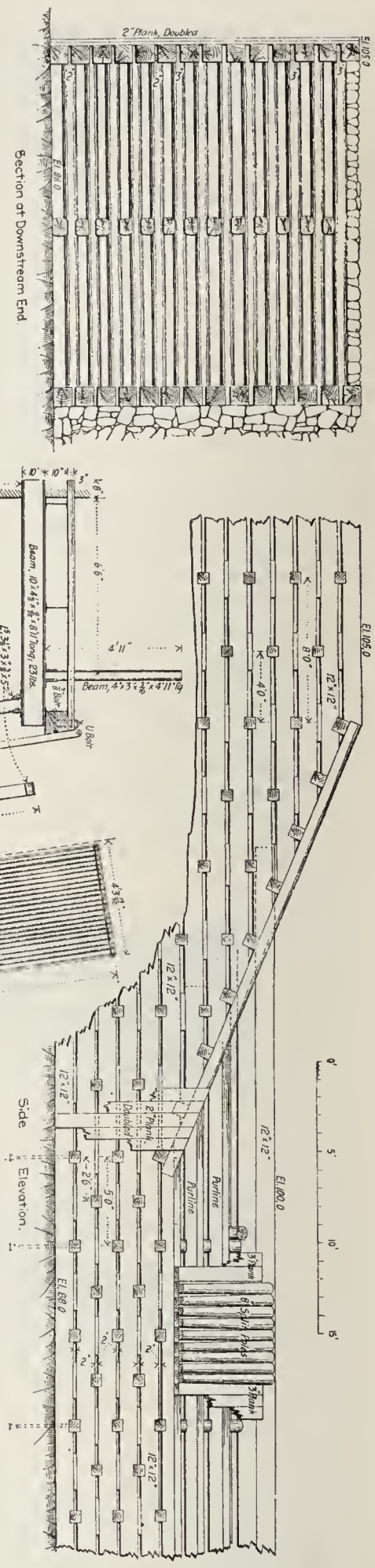
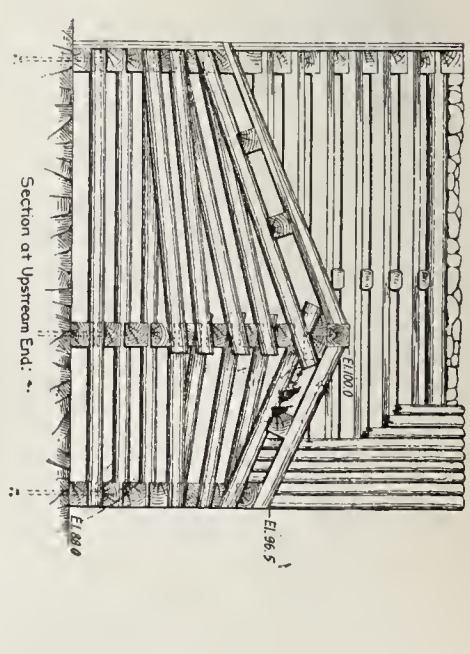



FIG. 6. CRIBWORK OF WING DAM AND GUARD PIER.



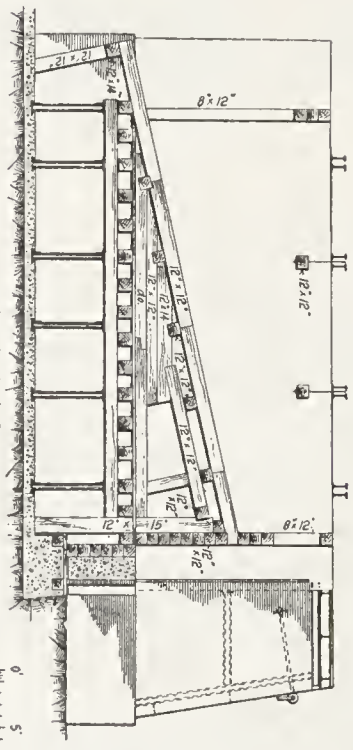




FIG. 10. DETAILS OF A WASTE WEIR IN MAIN DAM.

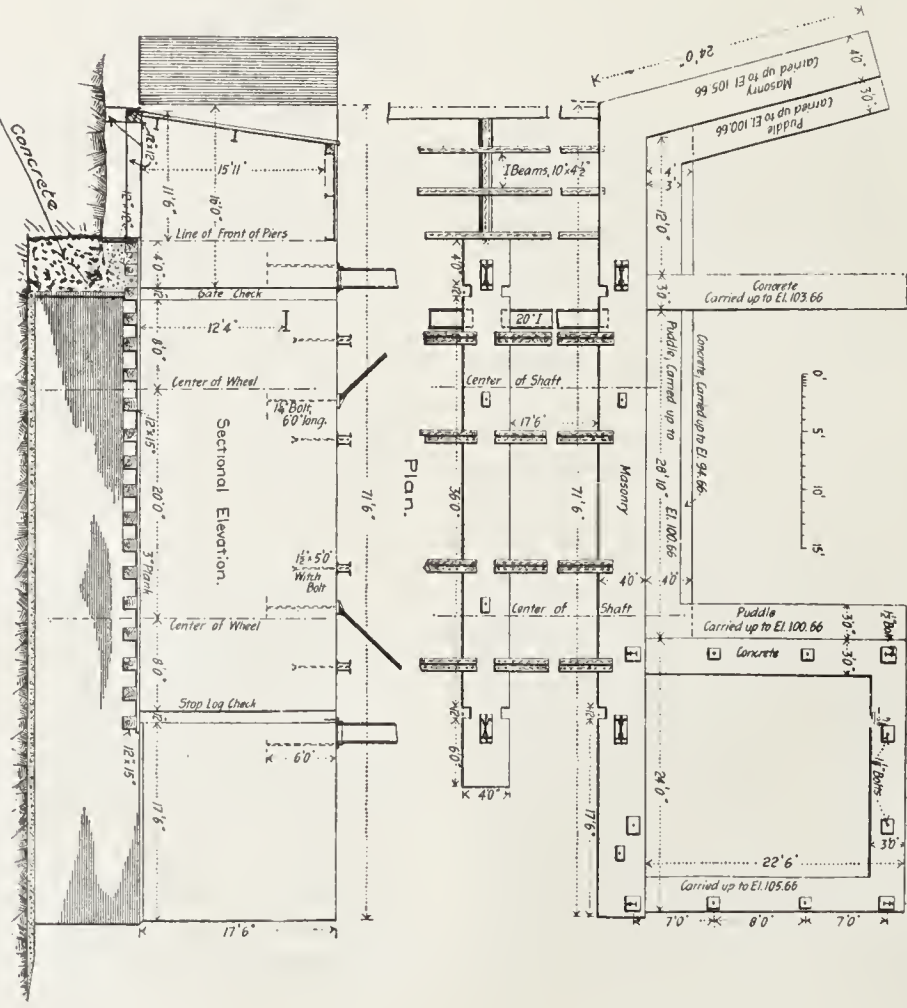



FIG 15. DETAILS OF SHORE ABUTMENT OF MAIN DAM.

The gates are intended to be raised and lowered by a travelling crane, and will probably be taken out and stored under water after the wheels commence running, as they would obstruct the light if left in position. The space between the top of the gates and the flooring of the building is filled with three-inch plank laid in the check and bolted to the upright behind the gates.

STOP LOGS.

The stop logs (Fig. 11) are 12 x 12 inches, laid into 8 x 12-inch recesses in the piers and braced by two sets of iron eye bolts, three in each brace, running diagonally down to the flume floor and pin-connected to the angle-iron fastenings, which are riveted to an iron plate 9 x ½-inch x 26 feet 4 inches bolted to the floor timbers. These bolts run out to a bevel casting, bearing on the channel iron uprights, and are provided with a nut at the outer end and can be removed if necessary. The uprights are formed of two 10-inch channels placed back to back with a space for bolts between, and held together with cross plates just under the bevel castings. These braces are so placed as to take all strain off the masonry piers.

RACK AND BRIDGE.

The rack and bridge framing rests on 12 x 12-inch timbers running lengthwise of the main dam and 11 feet 6 inches from the front of the piers, well supported by 12 x 12 uprights; a butting piece is placed at each pier and braced where necessary by 3-inch plank.

This framing is laid level with the flume floor and is omitted in front of the waste weirs. The rack and bridge rest on steel frame-work constructed of 6-inch I-beam uprights, 12-inch I-beams running lengthwise between piers to support the racks, while 10-inch I-beams are under the bridge floor, which is about 6 feet wide. The outer one of the bridge beams is faced with a 10-inch timber against which the rack rests. The rack (Fig. 12) is made of 3 x ¼-inch bars, 17 feet long, laid to 2¼-inch centres in sections 4 feet 3½ inches wide, well bolted through and with thimbles between each bar. Each section is supported on two castings (Fig. 13) so

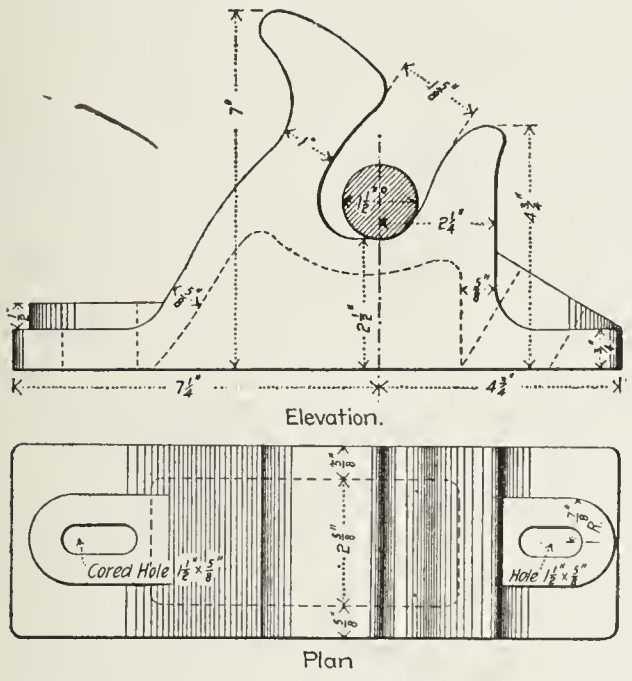



FIG 13.—CASTINGS FORMING HINGE SUPPORT OF RACK FOR PROTECTING THE TURBINESOF THE LACHINE RAPIDS POWER PLANT.

shaped that the rack may be swung over so as to lay on the head race bottom (which will be levelled off in readiness), or it can be easily taken out and replaced without the necessity of sending down a diver to unfasten the bolts.

The rack is constructed in this manner so that it may be taken out of the way in order to pass frazil through the wheels, in case the frazil should begin running before ice forms over the head race. If the rack were permanently secured in the ordinary way, the frazil would adhere to the rack bars and impede the flow of the water.

The bridge beams are floored over with 2-inch plank, and a rail is carried along the bridge about 2 feet from the edge, giving ample room for a man to rake the rack.

BOOMS.

The system of booms (Fig. 2) is as follows: (1) At the entrance to the head race on a very easy rake will be placed a boom 1,340 feet long, constructed in the form of a Howe truss, the chords being three 12 x 12-inch timbers, the main braces 3-inch plank, and the counterbraces 4 x 12-inch timbers.

The 3-inch plank is laid solid on the top and bottom, and between the 12 x 12-inch timbers and the 4 x 12-inch timbers are placed on edge between the layers of plank. The whole is securely spiked and bolted every 8 feet with three bolts, one through each 12 x 12-inch timber, the bolt diameters varying from 1¼ inch to 1¾ inch.

The boom is in sections 250 feet long, with a clear span of 220 feet, and is 14 feet wide and 4 feet deep. Its details are illustrated in Fig. 16. It will be securely fastened to the shore and the ice-

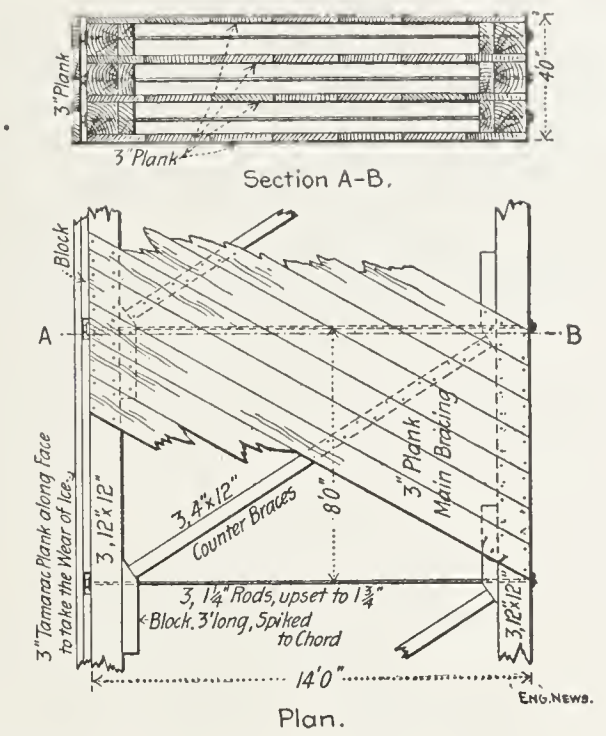



FIG. 16.—HOWE TRUSS FORMING BOOM ACROSS HEAD RACE.

breaker, and will be supported by four crib piers, 30 feet square, constructed of 12 x 12-inch timbers and filled with stone.

These cribs are made large, as they stand in about 25 feet of water. (2) At the lower end of the overflow dam will be placed a boom 1,000 feet long, constructed of three 12 x 12-inch timbers fastened with 1¼-inch chains and 1¼-inch bolts. This boom will be secured to a timber sunk into the ground at the shore end and will rest against a buttress on the overflow dam. It will be supported by four crib piers 13 x 22 feet, the fronts of which are at a slight angle to the sides, so as to obstruct the flow as little as possible. (3) At a distance of 250 feet from the front of the main dam are placed two piers, 13 x 22 feet, with ice breaking faces and constructed of 12 x 12-inch timbers.

Booms constructed of two 12 x 12 timbers, with bolt and chain fastenings, are secured to these and inclined to the waste weir entrance, forming a complete protection against any trash which may be allowed to pass the second boom (if the water level ever falls below the top of the overflow), and against ice which may form in the head race up to the second boom. All the boom piers are provided with suitable snubbing posts capped with galvanized iron and are filled with stone.

TURBINES.

Each flume will contain (Fig. 9) two special 54-inch Victor turbines, a total of 72, which are connected in sets of six turbines to twelve generators, four in each power-house. These wheels are set vertically on 3-inch plank flooring, and will develop 200 h.p. each, under a 11-foot head, a total of 14,400-h.p. Under this head they will run at 64 revolutions per minute and discharge 12,000 cubic feet of water per minute.

Each set of six wheels is connected by bevel core gears to a common jack-shaft, and this transmits their power at a speed of 175 revolutions per minute to a 3-phase generator of 750 K.W. guaranteed to stand 25 per cent. overload. The speed is regulated by a governor guaranteed to control the speed within two per cent. from no load to full load.

The gears and shaftings are supported on heavy cast-iron saddles resting on 15-inch I-beam girders, two beams to a girder, bolted at the ends to the piers by bolts running 24 inches into the piers. These girders also support by stirrups 8-inch I-beams on which the gear-shed flooring of 3-inch plank lies. This flooring is so arranged that the stop logs may be taken out and hatches are hinged over the space required to take out the head gates. At the back and front of the gear shed beyond the ends of the 8-inch floor beams the flooring rests on 12-inch timbers.

GEAR SHEDS.

The gear sheds (Fig. 14) are of steel frame with peak roof, Fink truss design. The uprights at each pier are lattice columns and are arranged to carry 21-inch I-beams on which a 25-ton hand power crane will run from end to end of the building, a distance of 975 feet. The distance from the floor to the eaves of the shed is 25 feet, to the peak 36 feet, and the distance between uprights, or the clear width of the shed inside, is 38 feet. A wooden sheathing of studding and planking will be run along the sides and covered with corrugated iron. Between the roof trusses, which are 21 feet 6 inches apart, 6 x 12 inch purlines will be laid. Over these two

layers of 1¼-inch boards will be laid, with two-ply 10-ounce roofing felt between, and the whole will be covered with four-ply plastic asphalt.

POWER HOUSES.

The power houses (Figs. 9 and 14) are built of steel frame, and the roof is of special design, the distance to the peak being 50 feet; 12-inch brick walls are carried all around the front, back and sides, except where the travelling crane passes through, above which a wooden partition will be run up with doors to close when the crane is not in use. Loads carried by the crane will pass through openings 12 feet wide on each side. The inside dimensions of the power houses are 64 x 44 feet. The flooring is of concrete covered with 1-inch slate to prevent dust rising from the concrete.

The generator foundations form the flooring as far back as they go; beyond them 12-inch I-beams are laid with terra cotta between over which three inches of concrete and slate is laid. The flooring is given a pitch of ¼-inch to the foot for drainage. A hatchway 4 x 5 feet, and a spiral stairway is provided for access to the vault-like recess below the generators and pipes, to carry the cables to the switchboard, etc., run through the floor.

On the massive arched foundations are to be placed the generators; these will stand 11 feet high above the floor, have a base 15½ x 10 feet, and weigh about 45 tons each. They are held down by four 2¼-inch bolts 12 feet long, which can be readily taken out if required. Two stone blocks, 30 x 24 inches x 16 feet, are placed under the generators, one at each side. Two 4-pole exciters of 75 K.W. capacity are placed at the down-stream end of the power house. They are belted to the main shaft and will each serve two generators, but either of them is capable of exciting four generators. The bases of the exciters are securely bolted down to the I-beams on which they rest.

SWITCHBOARD.

The switchboard arrangements are not yet completed, but they will probably stand on an elevated structure at the down-stream end of the power-houses; they will be built entirely of marble and finished to an ornamental design.

Power will be transmitted to the distributing station in Montreal, a distance of six miles, at a pressure of 4,400 volts. This will be carried by 36 No. 0 copper wires strung on double petticoated insulators on six cross arms. The poles are of lattice steel work set 6 feet into concrete, and are placed 100 feet apart. From this station the power will be distributed throughout the city in underground conduits.

The capital stock of the Lachine Rapids & Hydraulic Land Company is $2,000,000. The officers of the company are: President, G. B. Burland; vice-president, T. Pringle; managing director, W. McLea Walbank; directors, E. Kirk Green, Peter Lyall and S. Carsley, of Montreal, and Alexander Fraser, of Ottawa. The engineers of the work are Messrs. T. Pringle & Son, and W. McLea Walbank, of Montreal, and Dr. Cary T. Hutchinson, Postal Telegraph Building, New York city, is in charge of the electrical department of the work. The contractors for excavation, masonry and cribwork were Wm. Davis & Sons, Ottawa; for turbines, shafting, gears, etc., the Stillwell-Bierce & Smith-Vaile Company, Dayton, O.; for electric machinery, the Canadian General Electric Co., Peterboro, Ont., and for steel construction and pole line, the Dominion Bridge Company, Montreal.

There have been used in the work 8,700 cubic yards of concrete, 6,000 cubic yards of masonry, and 2,900,000 feet B.M. of timber; 225,000 cubic yards of rock have been excavated.

The writer wishes to acknowledge his indebtedness to Messrs. T. Pringle & Son, from whom the detail drawings used in the preparation of this article were obtained.

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*For* THE CANADIAN ENGINEER.

## THE OTTAWA WATERWAY TO THE GREAT LAKES

BY A. J. FORWARD, OTTAWA.

(*Concluded.*)

Besides ore, however, there must be taken into account flux fuel, labor and transportation facilities. The city of Ottawa is built on limestone. On this point Mr. Birkenbine's report says:

"Limestone is abundant in the territory about Ottawa, and the Geological Survey officers state that both limestone and dolomite, as well as intermediate qualities of magnesian limestone, are obtainable. It is therefore possible to find either near the mines or near the furnace location an abundance of limestone for flux."

Facilities for obtaining and cost of fuel are, perhaps, the two most important elements. To quote Mr. Birkenbine again:

"To appreciate the position of Ottawa to a fuel supply, we may first consider its position in relation to the anthracite coal region of Pennsylvania. Taking Scranton as a centre, the circumference of a circle which passes through Ottawa, would also pass through or close to Cleveland, Ohio; London, Ont., and Rouse's Point, N.Y. As the railroad connections between Scranton and Ottawa are nearly direct, and as there is no duty on anthracite coal, this fuel should be delivered in Ottawa at approximately the same all-rail rates that prevail to the other points named. Very satisfactory coke for furnace use is now being produced in Pennsylvania, 100 miles nearer Ottawa than Connellsville, and the use of such fuel would give Ottawa an advantage of fully 100 miles over Chicago in distance."

Pennsylvania coal can be brought in by direct all-rail routes as stated, or via the Rideau Canal. Nova Scotia coal comes as far as Montreal in considerable quantity, there entering into competition with American coal. It could be brought to Ottawa at very slightly increased cost. Within eight or ten miles of the city are extensive peat bogs, which might be successfully used for coking purposes Peat also occurs along the line of the Rideau Canal, and in the vicinity of Caledonia Springs, close to the Ottawa River. And in case of the location of furnaces here it would be worth while to inquire into the value of the refuse from the various saw-mills, which now is allowed to pollute the river. This might be used as a fuel when converted into gas, as at present practised in Norway and Sweden in the manufacture of iron of the highest quality. The location is also one of the most favorable in Canada for the manufacture of charcoal iron, for from the forests of the great Laurentian area might be obtained supplies of charcoal for years to come. Labor is plentiful, cheap, and of good quality. With waterways south, east and west, and railways radiating in all directions, and located near the convergence of all the great trunk lines of Canada which have been or may be built, Ottawa would be in an ideal situation to distribute the manufactured product. To the western market she would be as near by water as Hamilton, and 250 miles nearer to Montreal. The Canadian Pacific and Ontario railroads running north to the Ottawa River, could be supplied to the best advantage. With cheap iron, cheap lumber, cheap water-power, cheap electricity, and cheap transportation, manufactures would spring up in the Ottawa Valley, and would create markets. And clearly, all development of mineral and forest resources to the northward, as well as all settlement in that direction, will have the Ottawa River as their base of supplies in the future as in the past.

In these days of Deep-waterways Conventions we hear much said of the enormous traffic of the great lakes. It is interesting to note that nearly 75 per cent. of that is composed of lumber and iron. In view of that fact, and considering that these two products constitute our most abundant and valuable resources, residents of the Ottawa valley may be permitted to question the sweeping assertion that all Canadian routes to the seaboard are disqualified "because they run through a district that can furnish but very little freight in either direction." We have iron enough to supply the continent. W. C. Edwards, M.P., one of the most prominent lumbermen in Canada, referring to the extensive forest area, and commenting on the methods of Canadian lumbermen, recently expressed the opinion, from his seat in the House of Commons, that a very large output of lumber from this region might be continued indefinitely, if proper measures for forest conservation are adopted. Unless there is some material error as to the extent and nature of our resources, or as to the functions and effect of waterways in developing these, there appears to be ground for asserting that the opening of the navigation of the Ottawa River to the great lakes will accomplish more for the advancement of Eastern Canada than any public work in our history, not excepting the Canadian Pacific Railway. Its beneficial effects in aiding the settlement of the North-West, as well as the northern districts of Ontario and Western Quebec, are beyond the scope of this paper.

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THE report of the investigation commission appointed by the Dominion Government to inquire into the affairs of the Kingston Penitentiary reported that the sewage works of the prison were badly planned, improperly constructed, faultily equipped, inefficient in operation, extravagant to maintain, and revolting to attend. The engineer is not responsible for the design of the present system, but he is not blameless as regards its equipment and operation. In dealing with the water supply for prison purposes, there appears to have been the grossest incompetency on the part of the engineer. The heating system is said to be operated without regard to the favorable conditions which exist to secure economy in expenditure.

## STEAM ROAD ROLLER

The Good Roads Machinery Co. of Hamilton have been appointed agents in Canada for J. & H. McLaren, of Leeds, proprietors of the McLaren patent steam road roller, which has obtained a high reputation in Great Britain. It is a modification of the Gold Medal Traction Engine made by the same firm, and like it, is noted for simplicity, efficiency, economy and durability. The McLaren roller is made in various sizes from 7 to 20 tons weight, and an average machine will compress over 2,000 square yards of 4-inch metaling in a day of 10 hours at a cost of $5 to $6, including coal, men's wages, interest on capital, wear and tear, etc. The front rollers are carried on a patent swivelling carriage, by which a fruitful source of breakage is avoided, and at the same time it admits of rolls of large diameter, which turn easily and accommodate themselves to inequalities of the road. The hind rollers are mounted on the main axle, and the gearing, which is of the best steel, is so arranged and the position and width of the wheel so adjusted that the pressure per foot of ground covered by the hind rollers is assimilated as closely as possible to the pressure on the ground covered by the front rollers.

The boilers are made of the best quality of steel plates throughout, tested by cold water to 240 lbs. for a working pressure (if required) of 140 lbs. on the square inch. All the plate edges are planed up true, and all rivets closed by powerful hydraulic machinery. The steel spur gearing is practically unbreakable. The rollers are cast of a specially hard mixture of cast-iron to avoid undue wear. They are cast several inches wider than actually required, the extra width being cut off in the lathe from the top (or "spongy") side of the casting, so that perfect solidity is ensured for the full width of the roll. Each roller is fitted with scrapers on both sides, and the engine is fitted with a water tank, coal box, water lifter for filling the tank from any convenient source of supply, injector for feeding the boiler, as well as a pump worked by an eccentric on the crank-shaft. A powerful brake is fixed on the engine for working on steep ground, and all the working parts are thoroughly case-hardened. Each machine is fitted with a complete outfit such as firing tools, a pair of lamps, waterproof cover, and an assortment of working tools—hammer, cold chisels, screw keys, oil-can, etc., etc.

At a slight increase of cost the McLaren roller can be supplied on the compound principle, and it is claimed that these compound traction engines are the best proportioned and most economical on the market.

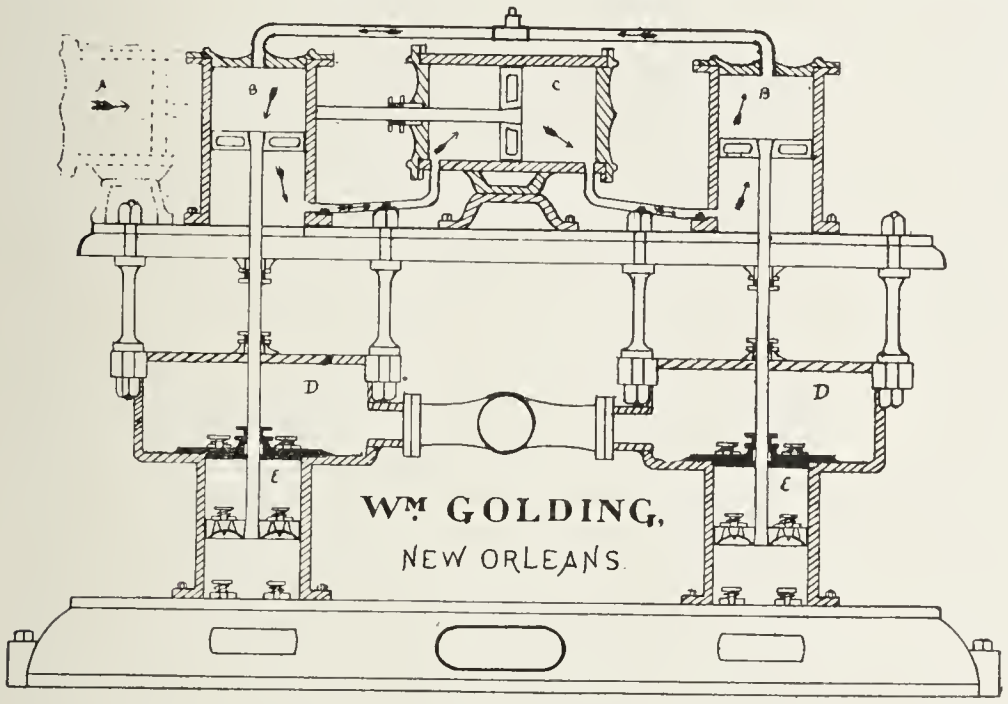
## TARIFF CHANGES.

The tariff revisions brought down by the Government, May 25th, contain evidences of a careful desire to conserve the interests of the manufacturers wherever possible. In discussing the duties on mining machinery, to which THE CANADIAN ENGINEER took exception in our last issue, the Minister said:

"In the matter of mining machinery, in our tariff resolutions were included a class of mining machinery exclusively used for mining, and provided that it should be admitted duty free. Under the old tariff there was a clause of somewhat similar character, restricting it to kinds of machinery not made in Canada. We found difficulty in the interpretation of that clause, and we have found there would be difficulty in the interpretation of our new clause, owing to the uncertainty as to what is mining machinery exclusively.

"We have had interviews with gentlemen interested in the manufacture of mining machinery, and also with many people who use such machinery, and after very full discussion, we determined to place 25 per cent. duty on certain articles of mining machinery, and to specify all the articles which we wished to make free. There are a few items of mining machinery which are made in Canada, and which are well made and satisfactory to mining people, and these classes will still have to pay 25 per cent. Then we place on the free list a large number of items which are desired by miners. Item 535 in the amended resolutions reads as follows. Mining, smelting and reducing machinery, viz.: Pressure or exhaust fans, rotary pressure blowers, coal cutting machines, except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore drying machinery, ore roasting machinery, electric or magnetic machines for separating or con centrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giants and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, gold mining slime tables, blast furnace blowing engines, wrought iron tubing, butt or lap-welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining."

Special concessions are made to some lines of metal manufacturers. The carriage-makers get considerable raw material free. Steel for toolmakers is reduced from 15 per cent. to 5 per cent. Scrap iron, which was $4 a ton under the old tariff and was reduced to $1.50, is further reduced to $1. Steel ingots and billets are brought down from $4 a ton to $2 a ton. Structural iron is reduced from 15 per cent. to 10 per cent. Iron bridges are increased from 30 per cent. to 35 per cent.




## TWIN PUMP.

The Twin Pump here depicted is believed by its inventor, Wm. Golding, C.E., New Orleans, to have a new system of actuation. Chambers *B C B* are filled with water. Steam cylinder *A*, shown in dotted lines on left upper corner of sketch, actuates the piston in chamber *C*, forcing the water into chamber *B*, under the piston: the water above the piston passes through pipe *E* to chamber *B* on opposite side, in the direction indicated by the arrows. The return stroke of the steam piston reverses the motion, thus causing the pump pistons to rise and fall with absolute certainty. There are many services for which this combination will have preference over all other movements, notably for air pumps and for moving large quantities of water; for drainage and for irrigation, where minimum first cost and cost of transportation and installation are important items.

## ACETYLENE LIGHT FOR MAGIC LANTERNS.

*Editor* CANADIAN ENGINEER.

SIR,—Within please find one dollar for another year's subscription for your valuable paper. I find much good information in it. While reading your account of Mr. Willson's calcic carbide works, of St. Catharines, I was forcibly struck with the idea of lighting my magic lanterns with the acetylene light. I would like you to give your readers information how to generate, and what to get to produce the quantity and cost for a sufficient light for a small house where there are now three or four gas lights. Yours kindly,

P. T. TROWERN,
Chief Engineer Asylum for Insane, Toronto.

[A description of the Niagara Falls acetylene gas machine appeared in our April number, and that apparatus, among others, is a serviceable one for the production of the acetylene light. The carbide and acetylene works operated by Mr. Willson at Merritton now ship the carbide in conveniently small tanks made of galvanized iron, each holding 100 lbs. of the dry carbide, which, we understand, is sold at $4 per tank, or $80 per ton. On this basis it is estimated that the gas produced by the carbide is equal to coal or water gas at 60 cents per 1,000 feet. Mr. Maundell, of Woodstock, has experimented with the following result: 1 lb. of carbide will produce five feet of gas, which will yield 240 to 250 candle power, at a cost of four cents. Thus 1¼ feet of acetylene gas will give

about 60 candle power for one hour at a cost of one cent.; while with ordinary gas, at $1 per 1,000 feet, 10 feet will yield 25 to 35 candle power for one hour at a cost of one cent, or about half the quantity of light. An improved burner for acetylene gas has been brought out in the United States, making a more economical light and giving better distribution than those heretofore in use, which are different to the ordinary gas burner, though attachable on the same pipe. The method of generating is referred to in the February and April numbers.—Ed.]

## PUMPING BY COMPRESSED AIR.

The Pohle Air Lift is a system of pumping water from artesian wells by means of compressed air without the use of any moving parts. Its advantages are claimed to be that it pumps larger quantities of water with greater economy and reliability. In addition sand or grit does not affect it, the water is purified and one air compressor (usually located in the engine room) will pump from any number of wells regardless of distance. Two properly proportioned pipes are placed in a well, the one an air pipe leading to the air compressor and connected with the other—the water discharge pipe—near its base, through what is known as the foot or end piece. The compressed air is forced through the air pipe into the foot piece and water pipe, and by its inherent expansive force, layers or pistons of air are formed in the water pipe, which lift and discharge the layers of water through the end of the water discharge pipe at the surface or tank. At the beginning of the operation, the water surface outside of the pipe and the water surface inside of the water pipe are at the same level; hence the vertical pressures per square inch are equal at the submerged end of the pipe, outside and inside As the compressed air is forced into the lower end of the water pipe, it forms alternate layers with the water, so that the pressure per square inch of the column thus made up of air and water, as it rises inside of the water pipe, is less than the pressure per square inch outside of the pipe. Owing to this difference of pressure, the water flows continually from the outside to within the water pipe by gravity, and its ascent through the pipe is free from shock, jar or noise of any kind. These air sections, or strata of compressed air, form water-tight bodies, which in their ascent in the act of pumping are said to permit no "slipping" or back-flow of water. As each air stratum progresses upwards to the spout, it expands on its way in proportion as the over-lying weight of water is diminished by its discharge, so that the air action, which may have been, say 50 lbs. per square inch at first, will be only 1.74 lbs. when it underlies a water layer of four feet in length at the spout, until finally this air section when it lifts up and throws out this four feet of water, is of the same tension as the normal atmosphere.

One of the many advantages which are claimed for this system is that the water is aerated, and this is an important consideration, as is usually acknowledged, and Prof. Thos. M. Drown, of Lehigh University, recently stated that the success of filtration is largely dependent upon aeration. The Ingersoll-Sergeant Drill Co., 26 Cortland street, New York, which construct plants on this system, states that it is already in successful operation in a number of cities in the United States.

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The annual report of the Minister of Railways and Canals shows that the number of miles of completed railway was 16,387, an increase during the year of 296 miles, besides 2 106 miles of siding. The number of miles laid with steel rails was 16,137. The number of miles in operation was 16,270. The paid-up capital amounted to $809,817,900, an increase of $5,177,341; the gross earnings to $50,545,569, an increase of $3,760,082, and the working expenses aggregated $35,042,655, an increase of $2,292,986, compared with those of the previous year, leaving the net earnings $15,502,914, an increase of $1,467,096. The number of passengers carried was 14,810,407, an increase of 822,827, and the freight amounted to 24,266,825 tons, an increase of 2,742,404 tons. The total number of miles run by trains was 44,500,692, an increase of 3,838,712. On the Intercolonial Railway system the loss on the year's operations was $55,187. The Windsor branch showed a profit of $20,085. The P.E.I. Railway showed a loss on the year's operations of $78,662 02. The Grand Trunk Railway carried 7,587,148 tons of freight, and the C.P.R., 4,576,632 tons. The number of passengers carried by the Grand Trunk was 5,077,671, and by the C.P.R., 3,036,619. The total gross earnings of the Grand Trunk amounted to $16,506,000, and of the C.P.R. to $20,175,000. The total net earnings were $4,962,000 for the G.T R., and $7,973,000 for the C.P.R. The passenger traffic yielded the C.P.R. $4,759,000, and the Grand Trunk, $5,002,000. The G.T.R. had no passengers killed during the year.

## LITERARY NOTES.

In 1894 a memorial was presented to the county council of Wentworth recommending that a prize be offered for a history of Wentworth. Acting on the memorial the council offered a premium of $100 for the best historical essay, and the prize was awarded to J. H. Smith, the inspector of public schools for the county. This has now been published, with some additions and illustrations, and those who may have the opportunity of reading this instructive pamphlet of 140 8vo. pages will heartily commend the judgment which awarded the palm to Mr. Smith. It is not commonly known that a white man entered the forests of Wentworth County as long ago as 1669. This was no other than La Salle, the intrepid French Canadian explorer, whose journeys are recorded by Galinn, one of the priests who accompanied him, and whose narrative is quoted from an interesting paper by B. E. Charlton, a former mayor of Hamilton. For the actual settlement of Wentworth we come down to about the beginning of the present century, and in that short time the settlement and development of the county—in population, wealth, education and in all that contributes to make a progressive and enlightened community—has been remarkable. In fertility of soil, wealth of orchards and gardens, charm of rural scenery, variety of agricultural products and intelligence of its inhabitants, Wentworth has become famous, and Mr. Smith's graphic sketch shows that it is also rich in historical records. Among these not the least to be proud of is the memorable battle of Stony Creek, in which a band of 704 British put to confusion and flight an American army of 3,500, and by this bold assault turned the tide of invasion from the whole province of Upper Canada. Mr. Smith's style is very pleasing, his language choice, and it is saying much for the value of his work that while dealing with local events, there are very few pages in his work which will not be both instructive and entertaining to readers who may have no personal interest in the county itself.

The address of George E. Drummond, Montreal, president of the Mining Institute of the Province of Quebec, on the history of the pig iron trade of 1896, read before the Institute at its last annual meeting, has been reprinted in pamphlet form. Mr. Drummond presents the claims of the producers of Canadian pig iron with his well-known ability and clearness, and gives, moreover, a very instructive review of the iron trade of Great Britain and the U. S. during the past year. While the large consumption of pig iron in Great Britain seems to show sunshine, Mr. Drummond sees clouds ahead there. A large part of the demand in Britain was for war office and navy yard contracts, while the large imports of American pig iron, taken in conjunction with the decreased exports of British iron products, indicate impending changes of great moment The combined output from Scotland, Cumberland and Furness district, and the Cleveland district of Britain, last year was 5,624,573 tons, or 601,622 tons over 1895; but this increase was only in the home trade, and the exports to France, Russia, Spain Portugal and Canada all showed a decline. Very little Scotch iron came to Canada, American pig being so much cheaper in this market—the difference being fully $4 per ton. It is estimated that only 2,454 tons of Scotch pig came to Canada last year, against 22,913 tons in 1892. Furthermore, the home mines in Great Britain are beginning to show signs of depletion, the "black band" being nearly worked out, and British consumers are seeking new mines in Spain to take the place of the Bilboa mines, which are also being worked out. The price of Spanish ore will therefore increase relatively and this will make American competition a factor all the more prominent as time goes on. The American production of pig iron in 1896 was 8,623,127 tons, which, though it showed a decrease of 9 per cent. since 1895, was still ahead of all other countries in the world Mr. Drummond computes the production of pig iron in Canada in 1896 at 61,839 tons, being an increase of 41 per cent. over 1895. This does not include the returns from Drummondville, Que., which had not been received. There was also produced 12,964 tons of Canadian steel, 1,243 tons of forgings, and 4,575 tons of puddled bars, etc. To produce this quantity the following Canadian materials were used: Ore, 82,705 tons; coal, 114,554 tons; coke, 46,219 tons; charcoal, 557,400 bushels, and limestone, 34,946 tons. Of foreign materials there was used at the Hamilton Blast Furnace Co.: American ore, 32,025 tons; or about 72½ per cent. of their total consumption; and of American coke, 30,217 tons. The Nova Scotia Steel Co.'s works used 7,269 tons of Newfoundland ore, 3,164 tons of Spanish ore; while the Canada Iron Furnace Co. (Radnor Forges) and the Londonderry Iron Co. used solely Canadian material. In the course of this able paper Mr. Drummond points out that in point of labor the worst kind of competition the Canadian iron producers have to contend with is the negro and convict labor of the Southern States. The latter is

"virtually a system of legalized slavery," the state prisoners being auctioned off to mining companies who pen the prisoners in the mining camps, and get the most out of them, paying the State so much per year per man. Mr. Drummond fairly argues that some sort of protection ought to be had against such a system of labor. Not the least interesting feature of Mr. Drummond's pamphlet is the copy of a petition signed by over 1,400 farmers, miners, merchants and others of the counties of Joliette, Vaudreuil, Nicolet and St. Maurice, addressed to the Dominion Government in behalf of a policy of encouragement to the iron industry of those regions.

The publishers of the *Canadian Manufacturer* are showing commendable enterprise in preparing a special issue containing the new tariffs of Canada and the United States. To this will be added the tariff of Great Britain—for, though Britain is a free trade country, its tariff of dutiable articles makes a longer list than most people imagine—and the whole will make a very valuable paper for reference purposes. This special number will be sold at 10 cents, and will be issued as soon as the Canadian and American tariffs are settled.

The magnitude of the paper and wood pulp industries of this continent are well set forth in a special number of the *Paper Mill and Wood Pulp News*, recently issued by L. D. Post, 21-23 Centre street, New York. This number contains 84 pages 12 x 16 inches, and the splendid machinery and appliances that now go to the equipment of the big paper mills are depicted in a fine series of photo-engravings. Mr. Post is to be congratulated on his enterprising paper. It is devoted to the various phases of the paper and pulp manufacture, and is published weekly.

"Notes on Copyright" is the title of a really valuable treatise on Canadian copyright by Richard T. Lancefield, the librarian of the Hamilton Public Library. Mr. Lancefield has made a study of this subject for several years, and he is the best authority on the subject in Canada to-day. The present work treats of copyright in general, and of the special features of the copyright law of Canada, of Great Britain, and of the United States. A chapter is given to the question of royalty, and the Canadian Acts of 1872 and 1875 are defined, and the text of the suspended Act of 1889 given. The provisions of the Berne Convention are set forth, and much other information presented in a clear and understandable form, and the forms of application for copyright are appended. Altogether Mr. Lancefield has presented the first complete text book on Canadian copyright, and it is published at the nominal price of 30 cents per copy.

"Railway Technical Vocabulary of French, English and United States Terms," by Lucien Serraillier, has just been issued from the press of Whittaker & Co, 2 White Hart street, Paternoster Square, London, E.C. Price, 7s. 6d As the author states in the preface, railway terms are comparatively modern; many have been coined independently in each country as required by the progressive development of railways, by the improvement effected in railway plant and appliances, and by the adoption of new methods, constructive and administrative. Some international nomenclature is needed which shall give the technical equivalents of these terms in each language, and thus save the time and labor often evolved in looking up special text-books for any terms which may occur either in foreign technical literature, or in the course of the annually increasing business dealings between home and foreign railways. It is to be hoped also that some understanding may ultimately be arrived at by which either a process, operation, or appliance shall be known by one name only in each language, so as to avoid the confusion and uncertainty which often arise when various expressions denoting the same object are adopted by different railways in the same country.

CATALOGUES.

A. B. Jardine & Co., Hespeler, Ont., have placed before the trade a handsome new catalogue of their machinists' tops, tube expanders and blacksmiths' tools.

Water Pumped by Compressed Air, is the title of a most interesting illustrated pamphlet which the Ingersoll-Seargeant Drill Co., 26 Cortlandt street, New York, is sending to its friends and those interested in the development of compressed air as an industrial force. A description of the Pohle air lift system will be found in another column.

The Montreal Pipe Foundry Co., Ltd., has issued a neat pocket-sized catalogue, which contains in addition to tables showing pressure of water in pounds per square inch for different heads, the thickness of metal and weight per length for different sizes of pipe under various heads of water, specific gravities and weight of a cubic foot of various substances, etc., and a number of pages for memoranda, which make it a very useful companion.

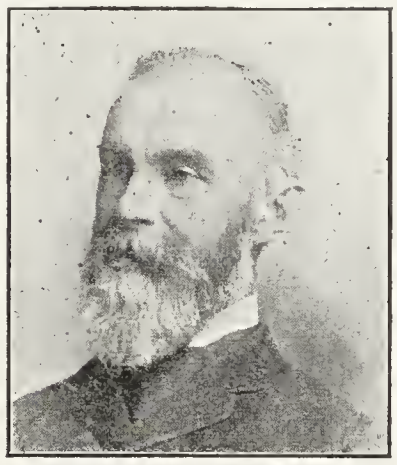
W. S. Rockwell & Co., furnace engineers, 26 Cortlandt street, New York, are sending their '97 catalogue to the trade in Canada, showing the advantages of the Rockwell improved duplex system for burning fuel oil.

The Clarence E. Van Auken Co. of Chicago, illustrates its catalogue of steam specialties by photo-engravings of some of the finest buildings in the United States, in the heating of which the apparatus manufactured by this firm is employed.

The full page illustration in the catalogue issued by M. Beatty & Sons, Welland, Ont., gives an idea of the variety and size of the contractors' and mining machinery which is turned out by this enterprising firm. Steam dredges, ditchers, derricks, shovels, hoisting engines, horse-power hoisters, hoisting machines, stone derrick irons, gang stone saws, centrifugal pumps and other machinery is shown, much of it as it appears in actual operation in the execution of contracts.

## THE LATE ALAN MACDOUGALL, C.E.

A serious loss was sustained by the engineering profession of Canada by the death of Alan MacDougall, C.E., which took place at Exmouth, Devon, England, April 23rd. Mr. McDougall was the third son of the late Col. MacDougall, of Edinburgh, Scotland, where he was born and received his education. He served his pupilage under Charles Jopp, consulting engineer of the North British Railway Company, under whom he had charge of several important works, especially on the Dalkeith Branch of the N.B. Railway. He came to Canada twenty-five years ago, and was employed on preliminary surveys and construction of the first sixty miles of the narrow gauge railways, as chief assistant under Edmund Wragge, consulting engineer, leaving the road before completion. He had charge of construction of the North Grey branch of the Northern Railway. He was for four years in the Department of Public Works, in charge of harbor and river improvements on the upper lakes and lower St Lawrence, until in the crisis of 1877 the staff was disbanded. Going to Scotland, he obtained employment



ALAN MACDUGALL, C.E.

on the North British Railway, as chief indoor assistant to the chief engineer; had charge of the survey and draughting department. Returning to Canada in 1882, he was a divisional engineer on construction of Canadian Pacific Railway for one season, after which he devoted himself to sanitary science, and commenced practice in Toronto, where he worked up an extensive practice in every branch of sanitary engineering and science. His opinions have been sought by municipalities in every part of the Dominion on waterworks, drainage, and other health questions, and also in Newfoundland, where he was offered the city engineership of St. John's, which he was unable to accept. Before leaving he received the thanks of the St. John's Board of Health for his services rendered during an outbreak of diphtheria. Among the numerous places he has advised on sewage and water supply may be mentioned: Stratford, St. Catharines, Port Arthur, Belleville, Peterboro, Goderich, Ont., and Brandon, Calgary in the North-West, and Vancouver, B.C.

Mr. MacDougall was married to a daughter of the late Dr. McCaul, in his lifetime president of the University of Toronto, and leaves a widow and four children, two sons and two daughters.

THE Gatineau Valley and the Pontiac and Pacific Junction Railway Companies are desirous of extending their lines into and through the city of Hull to the bank of the Ottawa River, to erect a commodious station at the junction of the railways, and to build a workshop for the use of both roads. An application has been made to the Hull city council, asking for the grant of these rights.

## IRRIGATION IN THE NORTH-WEST TERRITORIES.*

BY WM. PEARCE, DOM. SUPT. MINES, CALGARY, N.W.T.

The object sought to be attained by sending your society an article on irrigation in the North-West Territories, is not so much that the climate of Ontario is such that the subject is one of considerable interest to many in that Province, though one who has observed the beneficial effects of irrigation will unhesitatingly assert that in very many localities, and in the majority of seasons, irrigation, to a certain extent, would be beneficial and highly profitable; nor does he require the gift of prophecy to foretell that within the life of the present generation it will be practised to a very much greater extent in the humid districts than even the enthusiasts on the subject anticipate. Before leaving this branch of the subject it may not be out of place to observe that few, if any, that were reared in a humid clime, and afterwards lived in an arid or semi-arid one, where irrigation was necessary, but were impressed with the neglected opportunities in irrigation in the humid portions. Particularly is this applicable to gardening and the growth of trees. Further, you in Ontario irrigate to a much greater extent than you imagine. Every gardener, in watering his plants, shrubs and trees, sprinkling his lawn, etc., is engaged in irrigation.

Writers of good repute have asserted that the Garden of Eden was irrigated, and that assertion can be fairly if not fully proven, and slight reflection will convince anyone that all the ancient civilizations existed wholly in irrigated territory. The subject is not new, but older than the earliest records, so that no apology is necessary because of its newness.

There is any amount of scope for the inventive genius intelligently applied by the members of this association on lines for which your training has to a very considerable extent fitted you, and in which your tastes will no doubt find the most congenial employments, viz., in the solution of devices for accurate measurements of water and the division thereof. Although inventive genius of a high order has been brought to bear on these contrivances for centuries, they are far from arriving at anything like the accuracy desirable. This, to those who have not given the subject any attention, will no doubt seem surprising, but an investigation thereof will demonstrate its truth, and the attempt of its solution will be found most interesting even should the results not prove successful.

Another branch of the subject equally interesting and valuable viz., designs for dams for diversions of water from the beds of the streams, or for creating reservoirs for storage thereof, head gates, and other gates required along the systems, falls or drops for water which are necessary to a greater or less extent on all systems of any size, spillways or checks necessary to prevent the breaking of banks, etc., arising from local storms or cloud bursts, flumes of various designs for carrying water over or around obstacles of various kinds, tunnels, bridges, culverts, etc., the best manner of making the topographical surveys necessary, not only to obtain the information requisite to design the minor ditches or canals of any system, so that economy and thoroughness in their construction may be attained; also the same information over a lesser area required for the purpose of the distribution and application of the water when delivered at some point on or near to the land on which it is to be applied. Implements for levelling the land so that the water can be cheaply and thoroughly applied thereon. It may seem strange that after water has been applied on land for centuries that there should be room for ingenuity or a material improvement in this line, but such is the case; the conditions vary so that what may be suitable in one case may not be applicable in another, and with us where the products from irrigation must be sold at best at moderate prices, there is necessity for the greatest economy on the lines mentioned.

Anyone who may think this subject an uninteresting one will find himself agreeably astonished. Running water has a fascination for all.

In 1894 the Dominion Government instituted surveys, gauging of streams and collection of data necessary to ascertain the amount of water available, and those portions of the territories on which it could be best applied, also for the location of sites for the storage of water; this last has a very important bearing, as has also the conservation of forest areas.

The experience of other countries, particularly that of our neighbors to the south, has demonstrated that no time is to be lost in making the reservations for the purpose indicated—as settlement, the construction of roads and railways have naturally occupied the points which are most vital in storage of water, if such is to be stored at the minimum of cost and at the best points. At one point in the Rio Grande, the United States Geological Survey report that the creation of a reservoir at the best point, in fact the only one, will necessitate the reconstruction of a railway, which would involve the outlay of hundreds of thousands of dollars; this might have been obviated without material cost to said railway had the reservation been made before the construction thereof.

Up to the close of the season of 1896 the Canadian Irrigation Surveys had been extended over a considerable area. The complete work comprises 1,296 miles of line levels, 3,811 square miles of contour topographical surveys, and 44 detailed surveys of reservoir sites. In addition to this some 223 miles of location have been completed for proposed irrigation canals, some of which are of considerable magnitude. The question of the water supply available for irrigation in the portion of the territories requiring irrigation has been examined into; 319 gaugings of streams have been completed, and the discharge of a large number of springs, and the volume of numerous lakes measured. The information needed in attacking the many complex problems connected with the flow of or storage of water has necessarily to be of an exact character, and the field work in connection with the irrigation surveys has to be carefully performed, so that in some instances great rapidity is not attainable; however it will be seen from the above statement that good progress in this important work has been made.

There are now in operation in the Territories 157 irrigation canals and ditches supplying water to areas varying from 10 acres to 10,000 acres. The total area under ditch and capable of being irrigated therefrom comprises some 140,000 acres, of which only a portion is as yet being supplied with water, but this portion is being rapidly extended as fast as the land can be prepared to receive the water, and from present indications, and with fair encouragement, the growth of irrigation will undoubtedly be rapid.

Very full reports of what has been accomplished, illustrated with maps, plates and diagrams, have been issued by the Department of the Interior for the years 1894 and 1895, and the one for the past season will shortly be forthcoming, and any member of the association whose interest in this subject is aroused would probably obtain copies thereof by application to the secretary of the Department of the Interior.

The cost of irrigation in the United States has been $8.15 per acre for preparing the land and $12.12 additional. With us the cost will be considerably less.

The district of country which requires irrigation may be described as follows:

Bounded on the south by the international boundary; on the west by the Rocky Mountains; the other boundary being described as follows: Commencing at the intersection of the international boundary by longitude 102° west, thence northwest to latitude 51° 30′ north, thence west to the Rocky Mountains, containing about 80,000 square miles or upwards of 50,000,000 acres.

Its elevation on the east averages about 1,600 feet above the sea, and the western boundary of the cultivable district about 4,000 feet.

The duty of water will be high, as there is always considerable rainfall and the subsoil being a heavy clay. It is estimated that with storage facilities, which can be economically constructed, there will be water enough for seven or eight millions of acres.

The problems in connection with the application of water will require the highest statesmanship, so that it may be so distributed that the irrigated portions may be as proportionately as possible distributed around the non-irrigated portion, so as to make the latter contribute to the maximum extent as pasturage in connection with the irrigated portion.

The best mode of settlement to be adopted in the arid or semi-arid areas, has also to be solved. To utilize this vast area and obtain the best results, is a goal of the highest importance. This area must be devoted largely, if not wholly, to pastoral pursuits, and it is probable that the greatest volume of dairy products attainable on any portion of this continent, possibly within the same area in the world, may be raised in the tract under discussion.

It required considerable persistency on the part of a few who took up and agitated this question, to prevail upon our legislators to provide the legislation necessary for this subject, but in 1894 the country was fortunate enough to have an Irrigation Act placed in our statutes. It is probable in working out this question many defects will be found in same. It is hoped, however, that it will not be so productive of litigation as the Drainage Act has proved in at least one province in Canada. As the defects are discovered, they can, it is anticipated, be remedied by amendments to the said act. With us in the Territories, fortunately, the control of both the water and the land are vested in the same authority; thus we will

*A paper read before the Association of Ontario Land Surveyors.

avoid the great weakness that has been met with, and has proved so fatal to such a large number of irrigation enterprises in the western United States. It has also been attempted, and it would seem successfully, to have the administration thereof under strong central control, thereby avoiding the rock which has frequently proved so fatal, viz., disputes and litigation. On no subject, even in connection with rich and valuable mines of the precious metals, has there been so much heart-burning litigation, and in some cases many lives have been sacrificed in disputes arising out of water for irrigation purposes. It would prove much too lengthy to attempt in this to explain fully the provisions of the Irrigation Act, whereby such disputes are thought to be avoided, the making the title to water as secure as to land or any other property, doing justice to the consumer as well as the one who supplies the water, providing a speedy, equitable and non-appealable decision regarding any and all controversies which may arise out of the construction and carrying on of irrigation. None of the very many technical points or problems arising out of this subject have been attempted. It would make it much too lengthy, and had best be left and be taken one by one by any members of this or kindred associations. There are dozens of problems which each in itself would justify the production of a paper sufficiently lengthy, interesting and valuable to claim your attention at any one session.

He who makes a hobby of any subject cannot understand why his theme has not the interest to others that it has to himself, and it may be that to many of you this effusion may appear dry and uninteresting (it is at all events not a dry subject). But this promise can be safely given you, that at least 999 out of every thousand who take the trouble to enquire into this subject will be interested, and a goodly percentage will be as great enthusiasts as the writer. This is not a reckless assertion, but one fully borne out by experience. If even to a very small percentage of you an interest in this is aroused, the writer will be highly gratified and a thousand-fold repaid for the slight trouble taken.

## ASSOCIATION CANADIENNE DE SECOURS MUTUELS DES INGENIEURS-MECANICIENS.

The Mechanical Engineers' Society of the Province of Quebec, was formed in 1894. The object of the association is not only to insure for its members benefits in case of sickness or in case of death, but also to give them the technical instruction so necessary in our days. These lectures are given semi-monthly by outside specialists, or by members of the union. By an intelligent administration this society, though having paid large sums of money to sick members, has to-day a surplus a good deal more than some older societies. The election of its officers for the year 1897 took place on the 20th April, with the following results: President, E. F. Valiquet; 1st vice-president, H. Beauchamp; 2nd vice-president, M. Guimond; treasurer, W. Gendron; financial secretary, E Leroyer; recording secretary, A. Bélair; assistant recording secretary, Jos. Gingras; corresponding secretary, A. Tessier introductor, A. Habig; door-keeper, O. Tontaine; trustees, M. U. Lessard (president), E. Brisbois, A. Provost, J. Langevin, F. Lavigne, N. Depatie, Jos. Verdon; delegates to Central Council, Brisbois, Guimond; examiners, R. Drouin, E. F. Valiquet, H. Denis.

From a photograph by J. A. Dumas.

M. E. F. VALIQUET,

President of the General Association Canadienne de Secours Mutuels des Ingénieurs-Mécaniciens de la Province de Québec.

At a special meeting on the 4th of May, the ex-president, R. Drouin, installed the new officers. There in a short speech President E. F. Valiquet gave Ex-President R. Drouin a well-deserved compliment for his administration, and thanked him for his services to the association. We publish above the portrait of the new president and vice-president.

Mr. Valiquet is an employee of Rutherford & Sons, Attwater ave., Montreal, saw mills, as chief mechanical engineer, for the last five years.

M. HENRI BEAUCHAMP,

1er Vice-Président de l'Association Canadienne de Secours Mutuels des Ingénieurs Mécaniciens de la Province de Québec.

## BEFORE THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The following abstracts of papers were prepared by members of the C.S.C.E., and read at a recent meeting:

### Water-Power—Its Generation and Transmission.*

BY SAMUEL WEBBER, CHARLESTOWN, N.H.

The author arrives at the conclusion that it is practically possible to store and secure for power about one-third of the total annual rainfall. This rainfall he reckons at 42 inches as a fair average for the larger part of the United States east of Kansas and Nebraska, amounting therefore to about 3 cubic feet per second per square mile of catchment area. One-third of this or 1 cubic foot per second per square mile of drainage surface is therefore the supply which can usually, by the aid of storage, be relied upon.

A sketch of the evolution of the modern turbine is then given, the credit of inventing the inward and downward combined flow turbine, which is the exemplar of all modern American turbines, being given to A. M. Swain, a mechanic who had been employed at the Lowell machine shops in the construction of the Boyden and Francis wheels. The result of this change from the Founeyvon type is to produce turbines of equal power in one-half the space and at one-fifth the cost.

The first cost of turbine installations is discussed and itemized for several plants, and is shown to vary from $50 to $100 per horse-power. The cost of water power per horse-power per annum is estimated in three instances at $8.64, $10 and $11.05; and is stated to be generally covered by the figure $15 per annum per horse-power.

In the discussion the credit for putting in the first pair of turbines coupled together on a horizontal axis is given to Emile Geyelin, of Philadelphia.

### Water Power of Caratunk Falls, Kennebec River, Maine.†

BY SAMUEL M'ELROY, NEW YORK CITY.

The river basin is of about 5,917 square miles area, of which 3,800 square miles are forest, and 450 square miles are lakes and ponds, 311 in number. (Moosehead Lake alone has an area of 120 square miles.) Mean summer temperature 61° F. to 67° F., winter do. 19° F. With a large snow fall the thaw of the lower layers maintains the winter stream flow; and in spring the dangerous freshets of milder climates are delayed until the ice is, as a rule, brittle.

The Caratunk falls have large natural pondage above and below the falls, whose cascade has a natural fall of 28 ft.

Annual rainfall 44.5 inches (1839 to 1888), maximum 45".6 (1887), minimum 33".7 (1860).

There was no time to make a continuous gauge of the river; but from experience on this and other rivers a safe present plant outlay for 5,000 horse-power was determined upon.

The lowest permissible flow is discussed for various rivers, special reference being made to the lessons to be learnt from the Lowell and Lawrence water powers. The rainfall for 50 years of the Kennebec basin is analyzed, and the conclusion is arrived at that the fall is good now for 5,000 horse-power, as above, and has a great prospective value as the timber supply diminishes, and allows the Moosehead Lake, now impounded for logging purposes, to become available for maintaining an equable flow in the summer.

The cost of dam, flume, head-gates, wheel pit, etc., was in this case $15 per horse-power for the 3,500-h.p. actually provided on the

*Trans. Am. Soc. Mech Eng., Vol. XVII., p. 41.
†Am Soc. Mech. Eng., Vol. XVII., 1896, p. 58.

west side; cost of wheels for 3,000-h.p. about $9, or $24 in all. The fixed charges on this the author reckons at $5.24 per h.p. per annum.

For comparison the cost of a 3,000 horse-power steam plant in this pulp-mill (where no exhaust steam is used for other purposes) is calculated, and found to be $52-17 per h.p. per annum. (Coal $6 per ton.)

Reference is made to the commercial value of a water-power; that at Lowell with a 4,085 square mile basin being valued at $2,787,200; and at Lawrence with an area of 4,553 square miles, at $2,866,720.

Hundreds of feet of floating light wood frames are used in Maine in the races above the mills to promote ice formation, and prevent the production of anchor ice. At Caratunk the reach above the dam freezes for two miles up stream, with blue ice 24 inches thick, which effectually prevents the anchor ice from getting to the falls.

In the discussion Mr. W. S. Aldrich discusses curves of combined turbine and dynamo efficiency for various loads.

### The Underpinning of Heavy Buildings.*

BY JULES BRENCHAUD.

The writer refers to the great difficulties experienced in preventing injury, by settlement of heavy buildings, when it is necessary to excavate and build on the immediate adjacent building site.

The specific case treated is of a building which was to be carried 30 feet (2 stories) below the street level, over half of which had to be made water-tight, as it was below water level. The total depth of foundation being 45 to 50 feet below the sidewalk, these foundations consisted of close-fitting rectangular pneumatic caissons all around the exterior of the new building site and cylindrical intermediate ones for columns.

As every square foot of the property had to be built upon, the problem was to pin the adjacent buildings up during caisson sinking and construction periods. This was accomplished by placing vertical cylindrical iron columns in slits in the walls, extending from the foundation upwards. These were founded at the bottom on rock or very hard hard-pan, and at their tops the bearings were spread out by transverse horizontal slits in the walls, in which were placed nests of I beams on top of the columns.

The cylindrical columns were 10″ to 30″ in dia., the smaller ones being forced down by a 60-ton hydraulic jack, in sections 5 feet long, at a time, to proper bearing; some also were partially sunk by water jet. The larger ones under the heavier building were sunk by compressed air, as neither the water jet nor jack would force them through a layer of hard-pan to the rock.

The larger columns were first made of cast iron, but after one becoming injured by forcing past a boulder, the rest were made of riveted steel sections.

These columns were filled, after sinking, with Portland cement concrete.

The writer then details several similar cases where the application has been successful, and concludes by stating that while this method is not (evidently) of universal application, it will be found the best means of transferring the load of an adjacent building to a lower foundation with a minimum of obstruction to the building site about to be used, also that as these underpinnings are left in place, there is no danger of that slight subsidence which takes place when other kinds of temporary underpinning are removed.

[This method is evidently expensive, and only applicable when the bearing soil is poor, *e.g.*, quicksand—and the necessity imperative; when necessary it would appear to be a very admirable one.]

### Methods and Results of Stadia Surveying.

BY F. B. MALTBY.†

For good results from stadia surveying, both good workmanship and good equipment are necessary. The writer recommends for use a transit-theodolite having the same graduation on vertical and horizontal circles (preferably reading to 20″), with a telescope magnifying to not less than 30 diameters. Field of the telescope to be flat and as large as possible. Vernier of the vertical circle to be swung from the horizontal axis of the instrument, and to be provided with a good level, to keep its zero in position independent of the plate levels. Such instruments are not at present in common use. Rods to be of well seasoned white pine 5 inches wide, 12 feet long and ⅝ inch thick, shod with strap iron at each end, straps having hole in them to place over station nail. Rod to be well pointed, graduated symmetrically, and preferably after the pattern used by the Mississippi River Commission. The length of the rod divisions may be determined by trial so as to correspond with the wire interval of the instrument, or may be laid off to some standard of length. The last is perhaps preferable, as the average stadia constant can be determined with great accuracy by running over long lines under all conditions of weather and exposure, the exact length of such lines being previously determined by triangulation. Value of the stadia constant varies in practice according to description of work to be done. Usually it is from 100 to 125; with such constant the graduations on the rod should be meters or yards and tenths rather than feet, 3½ to 4 inches being the minimum graduation spot desirable in ordinary practice.

Party should consist of topographer, recorder, and as many rodmen and axemen as circumstances call for. Topographer can average 500 points observed in a day, and it is true economy to work the topographer and recorder up to their full capacity by supplying them with all the rodmen and axemen that they can keep busy. Topographical surveying is to define general features rather than precise points as land monuments, and care should be taken that the area covered should be taken in equal detail in all parts. To secure this, the writer advises the use of a small plotting board about 15″ x 20″, upon which a continuous plotting of the stations can be carried on to small scale as they are occupied, and the fact that all the area has been fully covered can be graphically demonstrated. The sheets are made to overlap in the usual manner, and are of great assistance in the final plotting. For reducing the observations, the Colby slide rule is recommended, and three reductions per minute are instanced as easily as possible with this apparatus.

The line of occupied stations is plotted by lat. and dep., or by distances and bearings from a printed circle on the paper. The latter is quicker but not so accurate as the former. For plotting the intermediate and side readings the Colby protractor is particularly recommended. About 3½ points plotted per minute is given as average work for two men.

Statements of the final errors of many stadia run lines are given, and the writer's opinion is given that a discrepancy of not more than 1 in 1,500 can be obtained in average work, and that this is considerably more accurate than ordinary chaining. Levels when the instrument is equipped with a level on the vernier arm of the vertical circle can be carried for all distances within 0.50 feet.

The cost of surveys made by stadia varies very greatly, and a few examples are given:—

City of Baltimore topographical work (including buildings, streets, alleys), etc., $1.50 per acre, 200 feet to 1 inch. City of St. Louis topography 73 cents per acre, 200 feet to 1 inch. Mississippi River Commission, 1,000 feet to 1 inch, including 5 feet contours, buildings, roads, fences, etc., 1891,.$36 per square mile. Missouri River Commission, 1895, $31 per square mile; minor instances from 20 to 50 cts. per acre. In the discussion it is stated that the inaccuracies of stadia work are less than those due to plotting and expansion of paper under varying conditions, that attempts at minute accuracy only add to the difficulties and expense of the work, and that the best use is made of the method when the work is carried on, without regard to the optic conditions of the atmosphere, and reduced by a constant obtained by stadia measurements of triangulation lines.

### The Liverpool Waterworks.*

G. F. DEACON, M. INST. C. E.

The Liverpool new water supply is taken from the Vyrnwy River in Wales, and the a queduct connecting Liverpool with the reservoir is about 76 miles long. It includes 4 tunnels, 6 railway crossings, 13 river crossings, and 6 canal crossings, the latter including the Manchester ship canal. These crossings are in most cases subways, though in some cases the aqueduct was carried overhead.

Lake Vyrnwy is said to be the largest artificial reservoir in Europe, its area being 1,121 acres, and its capacity 12,131 millions of gallons below sill of dam and above outlet to the aqueduct. The author states that the dam for impounding this lake is the first high masonry dam used in Great Britain, its extreme height from overflow to base of foundation being 144 feet. A carriage and footway 19 feet wide is carried along the crest of dam on masonry arches. The author states a novel feature of this dam is the employment of relief drains from the foundations emptying into a tunnel in the heart of the dam. The idea of these drains was to prevent the development of pressure due to invisible springs, which it was thought, when the reservoir was full, might accumulate to such an extent under the foundations as to be of importance as one of the forces to be considered having a tendency to overturn the dam.

To quote the author's words: "Along the base of each of the more important beds of rock, not within 15 feet of the faces of the

*Proc Am. Soc. C. E., Vol. XXII., Dec., 1896.

† Journal Assn. of Eng. Societies, Sept., 1896.

*Proceedings of the Inst. C. E., Vol. CXXVI.

dam, a drain was formed by the masonry between six inches and nine inches square, and from these drains funnels were carried up, in different vertical transverse planes of the dam, to above backwater level." There are 27 of these funnels in a length of 66 feet of the deepest part of the dam, which empty into a longitudinal tunnel 4 feet 3 inches by 2 feet 6 inches, from which a cross tunnel to face of dam serves as an outlet and for access to main tunnel.

The tunnel under the River Mersey was one of the most difficult parts of the work, and the author states was the first tunnel ever constructed by means of a shield, under a tidal or other river, through entirely loose material. This tunnel had a cast iron lining of nine feet interior diam., and it was driven through loose water bearing strata 51 feet below high water. Inside the tunnel was laid the aqueduct, consisting of two 32 in. diam pipes, of riveted steel plates. The author says the site for this tunnel was favorable for laying the pipes in the muddy bed of the river, but that parliamentary exigencies forced upon the corporation the construction of the tunnel, for which the site was the worst possible.

These water works were begun in July, 1881, finished July, 1892. The total cost has been about £2,300,000 for a supply of 14,000,000 gallons per diem, but the author claims it can be increased to about 40,000,000 gallons per diem for additional cost of £1,600,000.

# Electric Flashes.

W. B. CLOSE is now manager of the Toronto Suburban Street Railway Company, Toronto Junction.

THE new Victoria Bridge will carry the wires which will bring electric power from Chambly to Montreal.

E. SLADE has gone into the electrical supply business, in Quebec, and will handle chiefly lighting fixtures.

IN Quebec the Lower Town Street Railway Company has sold its franchise to the new electric company for $20,000.

WORK is to be hurried on the Quebec street railway. An opening on the 22nd is what the management is working for.

THE Brantford Electric and Power Co. is now running its new turbines, which are capable of developing 600 horse-power each.

NIAGARA FALLS SOUTH, ONT., has granted a franchise to the Lundy's Lane Electric Railway to run over certain streets of the town.

THE agitation for an electric railway to connect St. Catharines and Beamsville, Ont., is going on, and there are prospects of success.

A. O. GRAYDON, C.E., city engineer, London, Ont., is one of the provisional directors of the Chatham City and Suburban Railway.

WM. SNIDER & Co., Waterloo, Ont., electric light, have commenced building their engine room. A 75 h. p. Corliss engine will run the dynamos.

IT is proposed to extend the London, Ont., Street Railway beyond the asylum for the Insane to Pottersburg, and also to connect the city with the town of Lucan.

A CORRESPONDENT of the St. Johns, Que., *News* says that the proposition for an electric railway from Montreal running through the Eastern Townships to Sherbrooke, is not taken seriously by the township people.

COATES, SON & Co., bankers, London, Eng., recently placed an issue of £50,000 of the Montreal Royal Electric Company's shares, there being more offers than were applied for in the company's circular. The issue price was 140.

THE Aylmer Electric and Manufacturing Company, Ltd., applies for an Ontario charter to supply heat, light and power by steam and electricity in Aylmer, Ont.; capital, $20,000; the incorporators are H. H. McDiarmid, D. C. Davis, J. Simpson, Aylmer; J. W. Campbell, W. H Irving, Toronto.

IT is probable that Hamilton, Ont., will appoint an electrical engineer as assistant to the city engineer, owing to the increasing share of the engineer's duties which have to do with that subject. G. Black, Hamilton, is favorably mentioned for the position.

F. E. HARVEY, doing business as the Citizens' Telephone Exchange, with office at Waterloo, Que., has assigned. The assets are placed at $11,000 to $12,000, and the liabilities at $6,000 to $7,000. The principal creditors are: C. E. Harvey, Waterloo, $2,600; E. T. Bank, $1,000; John Bradford, Granby, $1,000; W. N. Call, Waterloo, $850. C. E. Harvey is curator.

A TELEPHONE cable has been laid across the inlet between Moodyville and Vancouver, B.C., by the New Westminster and Burrard Inlet Telephone Company, under the supervision of H. W. Kent.

HODGKINS & HOSHAL are building a factory, 40 x 60 feet, for the American Carborundum Co., Niagara Falls, Ont., in which the company will begin the manufacture of its product by June 15th, in order to hold its charter. Sufficient power to carry on work on a small scale has been obtained from the electric light company.

THE Consolidated Railway Company's systems in Victoria, Vancouver and New Westminster, B.C., are now owned and operated by a new company formed for the purpose of acquiring them in London, England The new company, which is called the British Columbia Electric Railways Company, Limited, took possession on the 15th of April and are making a number of improvements.

JUDGMENT has been given in the first of the trials arising out of the tramway disaster at the Pointe Ellice bridge, Victoria, B.C., May, 1896, the jury deciding that the city was liable for the disaster. The plaintiff, Mrs. Gordon, whose husband was killed, was awarded $10,000 damages; $7,000 to herself, $1,000 to the eldest son, $1,500 to the youngest child, and $500 to a step-son. A number of other suits will follow.

THE longest electrical transmission plant in the Dominion of Canada was put in operation a few days ago near Three Rivers, Que. This plant was installed by the Royal Electric Company of Montreal, for the North Shore Power Co., and transmits 700 h.p. from Grand Chute, on the Batiscan River, a distance of 17 miles, to the city of Three Rivers, Que., where the power is used for arc and incandescent lighting, as well as for power. S.K.C. two-phase apparatus is used throughout. A full description of this long distance high voltage plant will be published very shortly.

THE Hamilton *Times* says recently of the Cataract Power Co., of Hamilton, Ont.: A company has been formed to take Lake Erie water from the new Welland Canal at Allanburgh and from the Chippewa River at Port Robinson, and turn it into Lake Ontario via DeCew's Falls, utilizing the water power of the falls to generate electricity, which will be conveyed to Hamilton to pump Lake Ontario water into the city, to run our street and suburban railways, to light the streets and to move the machinery in the factories. J. Patterson expects that he will have 5,000 horse-power available four months hence, and 50,000 to 60,000 horse-power at a later date.

THE Toronto Street Railway Co. is celebrating the Queen's Jubilee, putting on the road 20 handsome open cars, to be known as "The Jubilee Set." Each car is 27 feet long, and 7 feet 6 inches wide, 6 feet longer than the present open cars. The extra length will allow a space of four inches more between the seats, adding greatly to the passengers' comfort. The cars are painted white and gold, carry bicycle racks on the back, and have double steps at the sides. The latest style of motor made by the Canadian General Electric Co. is used, and each car will seat 70 passengers. Manager Wanklyn and Superintendent Gunn maintain that the "Jubilee Set" are the finest open cars on the continent.

THE Sherbrooke Gas and Water Co., Sherbrooke, Que., has recently made extensive additions and alterations in its plant; the station has been enlarged, and there have also been installed two additional water wheels. The electrical plant has been increased by one 180 K.W. and one 75 K.W., "S.K.C." two-phase generators, in addition to the 75 K.W., S.K.C. two-phase generator which was purchased about a year ago from the Royal Electric Company, and which makes the plant one of the most complete incandescent plants in the Dominion. The management of the company has installed a power circuit from the alternating two-phase apparatus, and are now serving power and light successfully from the same generators and lines.

THE Packard Electric Co., Ltd., St. Catharines, Ont., has rceently placed upon the market its type "L" transformers. These transformers are claimed to be unique in design, and their efficiency at all loads is guaranteed by the makers to be greater than that of any other. The Packard Co. will, at the request of any central station, conduct tests for core loss, copper losses, regulation and insulation, of their type "L" transformers in competition with those of any other make. It also guarantees these transformers not to increase over 40° in temperature after running full load for eight hours. The all day efficiency is very high. One unique feature of these transformers, which will appeal to the central station and their line men, is that they require but one cross-arm upon the pole, and do not require any separate hangers; the arrangement for hanging being permanently attached to the transformer.

ELECTRICITY is to be used for pumping water for irrigation purposes at Korachien, Egypt.

THE electric light by-law, recently voted on in Chatham, Ont., was defeated by a majority in all the five wards of the town.

THE Cataract Power Co., Hamilton, Ont., has received permission from the city council to erect poles. The city will collect $1.00 per pole from the company.

THE Rogers Electric Co., of London, Ont., are installing a 200-light plant in D. S. Perrin & Co.'s biscuit works in that city. The Goldie & McCulloch Co. of Galt are supplying the engine.

LA Compagnie Electrique de Saint Etienne de la Malbaie applies for a Quebec charter, with a total capital stock of $5,000, headquarters in the parish of St. Etienne de la Malbaie: to exercise the industry of electricity in all its branches. The incorporators are as follows: J. Warren, Pointe au Pic; H. Simard, P. Maltais, A. Larouche, J. Couturier, A. Guay, La Malbaie.

ACHILLE GAGNON & Co., Victoriaville, Que, who began in December last furnishing incandescent light to the towns of Victoriaville and Arthabaskaville, have found it necessary to increase their plant owing to the rapid increase in their lighting. They have ordered a 75 K.W., "S.K.C." two-phase alternator from the Royal Electric Company, Montreal, as it is their intention to furnish power as well as light from the same generator and circuit. Their first installation was single-phase alternating, but finding that they could also secure some power business during the day, they decided to operate their plant 24 hours per day, and for this purpose secured an "S.K.C." two-phase machine, from which they serve both lights and power.

THE Boiler Inspection and Insurance Company announces that its special service department has arranged to extend the advantages of competent and periodical inspection to electrical dynamos and motors. The services of a competent electrical engineer, R. A. Ross, have been secured as consulting engineer, and skilled inspectors will make careful and periodical inspections, and do whatever is necessary in order to keep the motor or dynamo in proper running order. The chief advantages to motor and dynamo users in such an arrangement are, that the risk of having the power supply stopped is greatly lessened through the frequency of inspection, and the annual cost of maintenance being a fixed amount can be better provided for.

THE Quebec Court of Appeal has given judgment in the case of the Bell Telephone Company vs. the Montreal Street Railway Company. The appeal was from a decision rendered by Judge Davidson dismissing plaintiffs' action for $27,626.07, damages alleged to have been suffered on account of defendants building and operating an electric railway on the streets of Montreal. The first proceedings of the case were instituted by plaintiffs in January, 1894. It was maintained by plaintiffs that the current from defendants' wires had seriously injured many of the plaintiffs' telephone wires; that on account of the influence of defendants' wires plaintiffs had been compelled to construct costly return ground wires; that the defendants had not the proper authorization from the city council for operating its system now in vogue; that the damage to plaintiffs' wires could have been obviated by defendants using a double instead of a single trolley system; that for these and other causes plaintiffs should be awarded the sum claimed. In answer to these allegations defendants produced proof to show that the Street Railway Company had been given license to operate an electric railway on the streets of the city; that if plaintiffs had expended money on improving the telephone system defendants should not be held responsible for it; that the city council had the power to authorize an electric system to be operated on the streets of the city without first consulting plaintiffs; that said city council had in its contract with defendants specified that the electric system used by the street railway was the same as now in vogue; and that in consequence defendants were in no wise responsible if plaintiffs had suffered loss by its operation; that the streets of the city were as free for defendants to use as for plaintiffs. Sir Alexander Lacoste rendered judgment on the appeal, dismissing it with costs, upholding the judgment of Judge Davidson. The learned judge, after going exhaustively into the facts of the case, decided that the city council acted legally when it authorized electricity to be used by the Montreal Street Railway Company as a motive power; that they had power to sanction the system now used by defendants being operated in the city; and that, finally, the streets not being the private property of the Bell Telephone Company, it could not assume control of them and sue for damages; for these, and other reasons, the judgment rendered in the Superior Court was upheld and the appeal dismissed with costs.

# Mining Matters.

OIL was struck last month at the Parkhill, Ont., Mineral Oil Syndicate's test well on S. Atmore's farm.

GOLD has been reported from several new locations in Simcoe county, Ontario.

ANTHRAXOLITE is reported from Gooderham, Ont., near Lindsay. The deposit is said to be extensive.

FROM Kamloops, B.C., come reports of very rich mines situated in a fine grazing country, and within a few miles of the C.P.R.

THE General Mining Association, Ltd., Sydney Mines, N.S., has ordered two Lancashire boilers from I. Matheson & Co., New Glasgow.

ASBESTOS which is said to be a particularly fine quality is said to have been discovered by W. Bannister and Jno. Rutherford, on Fish Creek, 25 miles from Calgary, N.W.T.

As knowledge of the mid-east-Ontario mineral region increases, the gold-bearing area grows in size. It is now shown to extend north as well as east and west from Hastings county.

CLOSE to the Fire Mountain prospect near Harrison Lake, B.C., another claim has been opened up, the principal owner of which is J. Leckie, Vancouver. One assay ran $300 in gold.

FREE gold has been found, it is said, in the Black Bear. The lower workings of Le Roi show considerable free gold, and it is regarded as possible that it may develop into free milling mines.

ENGLISH experts who have been inspecting the large iron deposits in the vicinity of Conception Bay, Newfoundland—deposits more than 14 miles long—report favorably on the quality of the ore.

IT is now stated that the Deloro mispickel mines in Hastings County, Ont., are turning out $1,000 a day in gold. The company has, besides its regular staff, three gangs of prospectors hunting for fresh leads.

GOLD has been discovered at Jay's River Road, three miles from Milford, N.S. The lead is said to be over 100 feet wide, and consists of porphyry and pyrites, sprinkled with gold and galena. It assayed $24 to the ton.

GEORGE W. PIERCE and F. H. Lippett, part owners of the Colorado Ore Sampling Works, of Denver, Col., were recently in Slocan, B.C., looking for a site for ore sampling works to be established in that region.

THE first International Gold Mining Convention will convene in Denver July 7th, 1897, and continue in session during the 8th and 9th. This is the first step towards uniting the interests of those taking part in this most important industry.

ACCORDING to the Coldwater, Ont., *Planet*, Benjamin Dempsey and John Yates, of Midland, Ont., were in and around Coldwater and icinity recently, taking the heights of land and examining the ground, and have discovered oil in the neighborhood.

CHARLES R. MAY, of the Easton & Anderson Company, London, Eng., manufacturers of mining machinery, has been in the Marmora district recently superintending the erection and starting of a new ore crusher on the property of the Gold Fields Company.

DREDGING for gold is to be carried on extensively on the Saskatchewan this season. Six mining scows have been built at Walter & Humberstone's yard, Edmonton, this spring. All but one will use steam machinery. It is reported that work will start on three others shortly.

THE famous "Paris Belle" case will go to the Imperial Privy Council. This is the Nelson and Fort Sheppard Railway Co. *vs.* Jerry *et al.*, in which the railway claims under its Crown grant against the miners' claim. The property in dispute is situated in the town of Rossland, and is very valuable.

AN employee of the Canadian Gold Fields Company has discovered a very fine vein of gold-bearing quartz on the company's property in Marmora, and F. Landenberger, of Belleville, Ont., says that he has struck a rich vein 9 feet wide, of free-milling gold-bearing quartz on his property in the township of Gwinsthorpe.

SIR HENRI JOLY DE LOTBINIERE recently published a letter from the secretary of the B. P. Gold Property Co., Ltd., which offered him 20,000 fully paid-up shares in the company for the use of his name as a director. Such schemes are worked every hour of the day. How is it that Sir Henri's exposure is the only one made as yet? It is in the public interest to publish such matters. Sir Henri's reply was: "If I had the remotest idea of taking any shares in your company, the offer you make me by yours of twenty-second instant would be sufficient to prevent me."

THE announcement comes that gold has been found in paying quantities in Lavant township, Lanark county, Ont., on the farm now occupied by John Ferguson. Late last fall Barry & O'Brien, Renfrew, interested themselves in the find, and sunk a shaft to the depth of seventy-five feet. Samples were assayed and are reported to have given an excellent yield.—*Lanark Era.*

THE Ottawa Mining and Milling Company, of which the Hon. G. E. Foster and Messrs. Levi Crannell, A. W. Fraser, Geo. Hay, Hiram Robinson, John Coates, Charles Magee, E. Seybold, and J. Mather, are the leading stockholders, will, it is said, erect a customs stamp mill for gold ores on the Dick and Banning water power, about four miles from Rat Portage, Ont.

THAT the man who buys shares does not always buy a mine is well known, but it remained to be established that you might buy a mine and still have nothing, as below from an exchange: "The Orphan Boy, in the Big Bend country, considered a very valuable free milling proposition, with a large amount of ore on the dump, was sold under the hammer for $6,300 to satisfy the judgment of its manager, Mr. Haskins."

THERE is some great tunnel work being done just now on the Iron Colt, says the Rossland, B.C., *Miner.* The Iron Colt had made a contract with the Alberta company for the use of their tunnel, which is 350 feet long, not 300 as first stated, and starting at the end of this, with a depth of 160 feet, the Iron Colt tunnel will run 300 feet to connect with the shaft and pierce the ledge at a depth of 350 feet. Mr. Heacock, who ran the Alberta tunnel, has been engaged by the Iron Colt company to take charge of this work. The work is being done with a Rand giant drill—the largest drill ever brought into camp. Its cylinder is 3¾ inches in size, and with 90 pounds of compressed air it makes 300 strokes per minute, carrying 800 pounds with each stroke. It easily drills 18 inches in five minutes, a wonderful performance in the hard rock of this camp.

THE Government has determined on a vigorous administrative policy in the Yukon country. Thomas Faucett, Dominion Topographical Surveyor, has been appointed the first regular gold commissioner in that country, and with a staff of assistants, numbering seven, has started for the field. The party goes direct to Dawson City, at the junction of the Klondyke with the Yukon, and their time of duty extends over a period of two years. The duties of gold commissioner have until now been performed by Inspector Constantine, who is in charge of the North-West Mounted Police, but they have of late become so heavy that the departments, of necessity, had to be separated. To carry out the work as at present proposed it is believed the mining laws will have to be amended. William Ogilvie of the Department of the Interior will start for home when Mr. Faucett arrives at his destination, but other eastern officials will be sent out to engage in other departmental work. Among these will be a few surveyors, whom the government proposes sending to make a survey of the feasible waterways into the country.

# Railway Matters.

THE trackmen on the C.P.R. have recently received an advance of ten cents per day in wages.

THE G.T.R. shops at Brantford, Ont., are working more hours per week at present than has been the case for many years.

DIVISION Engineer Chapman, of the G.T.R. at Allandale, Ont., recently examined the site of the proposed new elevator at Midland, Ont.

R. MARPOLE has been appointed general superintendent of the Pacific Division of the C. P. R., in place of H. Abbott, who has resigned.

S. SECOMBE, G.T.R. car foreman at Montreal, has been ordered to London, Ont., to assume one of the foremanships in the car shops there.

A LOCOMOTIVE exploded in the Intercolonial round-house at Richmond, N.S., May 14th, and the building was wrecked and the railway tracks torn up.

THE G.T.R. will double track its line between Montreal and Richmond, Que., at once, in preparation for the increased traffic consequent upon the rebuilding of the Victoria bridge.

IT is reported that acetylene gas is to be tried for lighting purposes in carriages on the London (Eng.) and North-Western Railway; it has already been experimented on with satisfactory results.

BIDS are asked until June 15 for the purchase of first mortgage bonds, amounting to $1,497,324, and 10,640 shares of the capital stock, amounting to $1,064,000, of the Port Arthur, Duluth and Western. Toronto General Trusts Co. are the agents.

THE work on the new buildings at the harbor terminus of the Ontario, Arnprior and Parry Sound Railway is progressing rapidly. The company is building two large docks, some twelve hundred feet each in length, and a cross dock for coal.

THE office of assistant general manager of the C.P.R. has been abolished, and Thomas Tait has been appointed manager of the company's lines east of Fort William, office at Montreal, and William Whyte has been appointed manager of the lines west of Fort William, office at Winnipeg.

A BILL respecting the Canada Atlantic Railway Company has been approved, providing that the company may extend its line from the present terminus at Lacolle, St. John county, Que., to points on the northeasterly boundaries of the States of New York and Vermont, crossing the River Richelieu by a bridge at Lacolle. Five years are given far the completion of this work, and the company is authorized to issue bonds to the extent of $25,000 per mile.

IT is announced that Malcolm & Ross, railway contractors, have secured the charter of the Restigouche and Western Railway, a line projected to connect with the Baie des Chaleurs Road at Campbellton, N.B., and run to St. Leonards on the St. John River, a distance of 110 miles. At Van Buren, Me., just across the river from St. Leonards, the new line will connect with the Bangor and Aroostook Railroad.

MUCH comment is made upon the British Columbia Government's plan for bonusing the Cassiar railway. The Cassiar country is to a certain extent like the Yukon, a rich gold country of immense area, but difficult of access, and dependent upon the coast for supplies for the miners. The application for this railway has been made by Warburton Pike, the great hunter. The Government promises to lease for 50 years to the company blocks of land not to exceed 10,240 acres per mile for each mile of road built. For this the railway must pay one and one-half per cent. royalty on all precious metals taken out, $50 a year for each claim taken up, $100 a year for every transfer of a claim, 50 cents per thousand for milling timber cut, and 25 cents per cord on cordwood, and 5 cents a ton royalty on any coal mined. These railway lands during the term of the lease are open to entry by free miners who, however, must give the company a half interest in any mine they stake out.

# Industrial Notes.

CALGARY, N.W.T., recently voted $3,000 to replace the Elbow bridge.

CANADA MILK CONDENSING Co., Antigonish, N.S., has been incorporated.

THE Mac Machine Co, Ltd., Trail, B.C., is building a foundry 40 x 50 feet.

A DAM and bridge were carried away by a flood at Ile Verte, Que., recently.

A NEW Methodist church to cost $12,000 is to be erected at Renfrew, Ont.

THE Matane, Que., River bridge was carried off by a freshet a short time ago.

E. CANNIFF, of Winnipeg, has perfected a machine for preventing prairie fires.

THE Whitelaw Trading Co. is establishing a central butter factory at Brandon, Man

THE capital of the Prescott, Ont., Elevator Co., Ltd., has been increased from $175,000 to $300,000.

CITY ENGINEER MURDOCK, of St. John, N.B., recommends the installation of an additional high level pumping plant at Silver Falls.

SENATOR SNOWBALL'S saw mill at Chatham, N.B., has been thoroughly overhauled and new machinery added at a cost of $10,000.

BARBER & WATSON, iron founders and manufacturers of water wheels, Meaford, Ont., have dissolved partnership. C. Barber continues the business.

JOSEPH ROGERS' new sawmill at 16 Island Lake, Montfort, Que., is nearly built. It is to have a complete modern equipment and is expected to be running in about four or five weeks. Mr. Rogers is the pioneer settler of this vast lumbering district.

GEO. VICK & SONS, Orillia, Ont., will rebuild their flour mill at once.

CLARK & UTLEY, of Salmo, B.C., are building the bridge across the Salmon River.

SAULT STE. MARIE, Ont., is agitating for a sewage system to cost at first about $40,000.

THE Wire Fence Manufacturing Co., St. John, N.B., is shipping its product to the East Indies.

M. ROBSON, Ayr, Ont., will build an elevator at once to take the place of the one recently burned.

THE stand-pipe of the Deseronto waterworks was completed last month by A. Davis, engineer, Montreal.

THE moulders in the McClary Manufacturing Co.'s stove-works are fully employed after a five weeks' lay-off.

THE bridge across the Bastican river at Price's Mills, St. Stanislas, Que., was carried away by a freshet recently.

TENDERS have been let for enlarging and improving St. James' church, South London, Ont., at a cost of about $6,000.

ROUELLE & HALLACK, late of Seattle, under the style of Robson Milling Co., will establish a sawmill near Robson, B.C.

A CONTRACT for a new public school on Albion street, to cost $14,800, has just been let to Schultz Bros. of Brantford, Ont.

BRANTFORD, ONT., is trying to secure a furniture manufacturing firm to occupy the Bain wagon works building in that city.

THE Maria Pulp and Timber Company, Maria, Quebec, on the north of Bay Chaleur, expect to begin work the 1st of June.

THE by-law granting a bonus of $6,000 to the Bowmanville Rubber Manufacturing Company was carried by a large majority, May 22nd.

WILLIS CHIPMAN, C.E., Toronto, and Col. T. H. Tracey, C.E., of Vancouver, have been asked to estimate on a sewage system for Rossland, B.C.

THE McEachren Heating Co. has decided to build a new pattern shop. It will be added to the old Cant foundry building that the firm recently purchased.

PLANS have been invited by the New Brunswick Government for a new bridge across the Big river at Bathurst, N.B., to be of steel, with stone buttresses

IT is estimated by J. A. U. Beaudry, C.E., that the cost of improving the Sherbrooke, Que., water works, if the city should take control of them, would be $80,000.

LEATHER & WATSON, steel and iron merchants and agents for railway equipment, Hamilton, have removed to their handsome new offices at the corner of King and James streets.

THE pipe foundry of J. & C. Hodgson, near Montreal, is to be opened soon. The factory has been closed during the last four years, owing to the duty on their raw material being too high.

MYER & WHITE, gas and gasoline engine manufacturers, Auburn, Indiana, have written the Mayor of Hamilton, Ont., with reference to the establishment of a branch of their industry there.

THE MacGregor-Gourlay Co., Limited, Galt, Ont., is now turning out the semi-automatic bicycle hub machines, and recently shipped one to the Welland Vale Bicycle Co., St. Catharines, Ont.

IT is said that Mr. Windler, of New York, has bought lands on the Saguenay river, Que., from Terres Rompers to Caron's Falls near the mouth of Riviere aux Sables, and will build a pulp factory there.

THE Carnegie Steel Co. has closed one of the largest contracts it ever made. It is for 18,000 tons of steel to be used in the construction of the new bridge, to replace the Victoria tubular bridge at Montreal.

THE property and plant of the Lunenburg Iron Co., Ltd., were sold recently to G. N. C. Hawkins, acting for the People's Bank, for $4,000. It is expected that the company will resume business shortly.

THE John Watson Mfg. Co., Ltd., Ayr, Ont., capital $75,000, will manufacture agricultural implements, etc. The incorporators are: J. Watson, sr., J. D. Watson, W. D. Watson, A. E. Watson, E. D. Watson, Ayr, Ont.

A NEW acetylene gas machine, the invention of James G. Kerr, a young Canadian of Niagara Falls, Ont., is now claiming attention. It is claimed the invention permits of replenishing the supply of calcium carbide, from which the acetylene gas is generated, without allowing any of the gas in the machine to escape, or in any way interfering with its working. The spent carbide is also removed at the same time, the whole operation occupying less than two minutes time, and is done without soiling the hands.

THE Irondale, Bancroft and Ontario Railway bridge over Baptiste Lake was wrecked not long ago. The bridge is 1,922 feet in length, with pile approaches at either end, the centre spans being upheld by wooden piers.

WILLIAM JESSOP & SONS, the well-known steel manufacturers of Sheffield, contemplate having a permanent branch in Toronto, and will erect a new warehouse this year if a suitable building cannot be obtained ready to hand.

ALBERT E. REED, a large paper manufacturer of England, has purchased the Masterman sulphite pulp mill, on the Miramichi river, N.B. He proposes to enlarge the capacity of the mill, so as to bring its product up to 30 tons per day.

THE Minister of Public Works has decided to at once proceed with the construction of a fireproof roof for the Western Block of the Ottawa Parliament Buildings, to be built of terra cotta and iron. The work will be done by day labor.

THE St. Raymond Company, of St. Raymond, Que., is seeking incorporation, to carry on business as pulp manufacturers. The promoters are J. Macfarlane, F. W. Evarts, W. Drake, G. F. O'Halleran and E. H. Barber, and the capital stock $50,000.

CARLETON PLACE, ONT., will probably buy a hook and ladder truck with chemical engines, as at present the town has only one steam fire engine, and the underwriters have notified the council that the rating will be changed if better fire protection is not afforded.

PROFESSOR C. H. MCLEOD, superintendent of McGill College Observatory, has reported to the Department of Marine that finally the longitude of Montreal has been determined. The difference between the true latitude of Montreal and that previously stated is about eight feet.

THE George White & Sons Co., Ltd., of London, Ont., will be incorporated to carry on the machinery manufacturing business of Geo. White & Sons. Capital, $170,000. The incorporators are: G. White, H. B. White, H. J. White, W. White, F. J. White, E. A. White, London, Ont.

ENGINEER BUCK, who superintended the drawing of the plans and construction of the new arch bridge at Niagara Falls, is now in the employ of the Upper Suspension Bridge Company, preparing plans for a new bridge of similar construction. The new bridge will be over 1,200 feet long.

THE authorities of the Methodist Church at Aurora, Ont., are among the first to adopt the acetylene gas for church illumination. They have placed an order for a 50-light plant with the Niagara Falls Acetylene Gas Machine Co., and the church will soon be lighted with the new illuminant.

THE firm of Schlistig Bros., Brooklyn, N.Y., has had a representative in Toronto lately looking into the prospects of establishing a glue and button factory in Canada. They have practically decided to establish such a factory, costing $500,000, and employing between 200 and 300 hands.

G. W. YARKER, on behalf of the Duryea Motor Wagon Co., New York, has obtained permission from the Dominion Government to import free of duty, into Canada, a sample motor delivery wagon for three months, but not to be used for hire. The wagon company is looking for a manufacturing site in Canada.

THE G.T.R. foundry at Hamilton, Ont., is to be operated in future by a private company, which will make all the car wheels for the G.T.R. in Canada. Messrs. Griffin, of St. Thomas, Ont., and Drummond, of Montreal, are the chief proprietors of the new company. The iron used will be from the Radnor, Que., forges.

J. A. & W. B. HONEYMAN, owners of the Union Iron Works and the City Foundry of Portland, Ore., have decided to erect a foundry and machinery shops in Nelson, B.C. They will make iron and brass castings, manufacture boilers, mining and steamboat machinery, and do general machine manufacturing and repairing.

THE Richmond Industrial Company has abandoned the dam and factory property in accordance with the judgments of the Superior Court and the Court of Review, and dropped the appeal before the Supreme Court. A curator to the property will now be appointed by the judge, and it will be sold to satisfy the town's claim for debt and costs.

THE Toronto Industrial Club, Lt'd, proposes to build an apartment house to accommodate 600 people. Proposed capital, $300,000. In this connection it is only necessary to remind investors that well-finished houses, in excellent repair, to accommodate families of, say, five persons, can be had in Toronto within one minute's walk of the electric cars, at from $6 to $12 per month.

ADAM HOPE & Co., wholesale hardware men and dealers in iron supplies, Hamilton, Ont., have assigned. The trade liabilities are placed at $15,000 and indirect liabilities at $60,000. The Bank of Commerce and Bank of British North America are interested to the extent of $45,000 advanced on warehouse receipts.

THE engineer's plant for the sewage works of London, Ont., include a steel highway bridge across the river at the foot of King street, having a 163-foot span, with 305-foot steel approach on the east side and 153 feet on the west side. The roadway would be 16-foot with a five-foot foothpath. The bridge is necessary to carry a main sewer, and the traffic arrangements are supplementary to this.

THE International Association of Machinists, in convention at Kansas City, Mo., in May, elected the following officers: President, James O'Connell, Chicago; grand foreman and editor of the *Journal*, B. Douglas Wilson, Chicago; secretary-treasurer, George Preston, Chicago; general executive board, Harry Smith, New York; J. Holmes, Toronto, Ont.; Stewart Reed, Toledo; P. G. Conlan, Kansas City; Hugh Doran, Chicago.

WATSON & MCDANIEL, Philadelphia, for whom Garth & Co., Montreal, are agents, are getting out patterns and putting in som fine matrice tools to produce a line of steam separators, back pressure valves, and entirely new straightway and duplex valves, mainly for bottom blow-off for steam boilers, and are also introducing a new hydraulic operating valve recently patented by Mr. Riggin, who has charge of the hydraulic department of Penna R. R. shops at Altoona, Pa.

THE Master Plumbers' Association of Toronto met May 12th, W. J. Burroughs, president, in the chair. Nine new members were admitted. The principal business of the evening was the election of delegates to attend the convention, to be held in this city from July 1st to 3rd. The Palmer House was selected as headquarters for the delegates, and the meetings will be held in Pythian Hall. It is expected that every part of the Dominion will send representatives. W. J. Burroughs and A. Fiddes, on behalf of the Toronto Association, will represent the National Association, and the following the Toronto Association: Geo. McGuire, Alex. Purdy, Jas. B. Fitzsimmons, K. T. Allison, Jas. Wilson.

OUR Canadian pulp factories should take advantage of the hint conveyed in a recent report regarding the making of a new material for flooring, wainscoting, etc., and which is being exploited largely by German manufacturers of wood pulp. The pulp is dried and desiccated into a dry powder, which is put up into convenient sized packages and sold to builders and consumers generally. This powder is all ready to mix with water like ordinary cement and is spread over the surface intended to be covered. It dries quickly and adheres closely to the surface and may be tinted any color desired. It is in a certain measure fire proof, and can, it is said, be smoothed with a plane like ordinary wood.

MAUDE BENNETT, the widow of the late Dickson P. Cottingham, in her quality of sole executrix to the estate of her late husband, doing business at 1822 Notre Dame street and 19 Phillips square, has assigned at the demand of Major Freeman. The liabilities amount to $17,155. The principal creditors are: Canada Paint Company, $2,854; R. C. Jamieson & Co., $2,884; Sherwin Williams Company, $1,483; W. Warland & Co., London, Eng., $935; Meakins & Co., $715; Montreal Rolling Mills, $708; B. & S. H. Thompson & Co., $702; J. Cox & Son, $624; A. Ramsay & Son, $593; Thos. Bryan, London, Ont., $525.

IT is about thirty-three years since James Morrison started a brass foundry in Toronto. In 1893 the business had grown to such an extent that a joint stock company was formed with an authorized capital of $300,000. Of this sum two-thirds was paid. Losses by bad debts in the business and unfortunate investments made by Mr. Morrison proved too heavy a drain on the business for its continued prosperity. At a meeting of creditors an offer of 20 per cent. cash was made to unsecured creditors on unsecured liabilities of $38,000, and accepted by all present. The Jas. Morrison Brass Manufacturing Co. will continue the business as formerly.

THE fencing manufactured by the Page Wire Fence Co., of Walkerville, Ont., has evidently found favor with consumers throughout Canada, as the company's warehouse is almost depleted of stock, although new looms were added this year sufficient to increase the capacity of the factory by sixty per cent. The wires made for the Page patent fence are hard spring wires specially manufactured for this particular purpose; and in the moving of the cross wires, the running wires are coiled in such a way that while all the necessary strength is imparted to the fence, the individual wires have the elasticity needed to save it from the effects of a sudden blow.

AS a preliminary to the repair to the reservoirs the Montreal water works department will do the following work: Two new 30-inch values, one 24-inch valve and one 20-inch valve, $3,500; altering valves on pipe track, $6,500; connecting the 30-inch main from No. 1 turbine to the two 24-inch mains in the tunnel at the wheelhouse, $1,200; connecting the 30-inch main of No. 1 engine to the 30-inch main of No. 1 turbine, $1,600; connecting No. 2 engine to the 30-inch main of No. 1 engine, $1,700—a total of $14,500.

# Marine News.

A STEAMER service between Cleveland, O., and Rondeau, Ont., is proposed.

THE Thousand-Island Steamboat Co. has amalgamated the Alexandria Bay Steamboat Co.

THE C.P.R. has almost completed its new steamer at Roseberry, B.C., for use on Slocan Lake.

WM. WALKER, Kincardine, Ont., is engineer on the steamer "Crandella," Lindsay, Ont., this season.

THE dredging of the Thames from Chatham, Ont., to Lake Erie, is ordered by the Dominion Government.

A. M. PHILLIPS, acting superintendent, has been appointed superintending engineer of the Rideau and Tay Canals.

MICHAEL DELANEY'S tug "Charles Stewart Parnell" was destroyed by fire, May 20th, at the Grand Trunk wharf, Owen Sound.

THE St. John, N.B., city council is pushing the harbor improvements, and wharf building and dredging are going on vigorously.

CHIEF ENGINEER ANDERSON, of the Marine Department, has chosen a location for a lighthouse on Flower Pot Island, P.E.I., which will be built during the summer.

THE steamer "Nellie H.," recently launched at Chatham, N.B, was built by J. M. Ruddock, at the Miramichi Foundry's yard. She is 45 feet long; beam, 9 feet.

JAS. ROBINSON'S new boat "Irene," is now being fitted up at the Miller Chatham Foundry and Machine Works, Chatham, N.B. She is 36 ft. 3 in. long; 11 ft. 3 in. beam.

P. P. YOUNG recently launched his new steamer "Majestic," for service on Stoney Lake, Ont.; Capt. Scollard will sail the "Majestic," and Ed. Young will be mate.

THE Fort William *Journal* reports that J. Servais has placed the machinery in a new boat at Wabigoon. It is a flat-bottomed boat fifty feet long and drawing two feet of water.

THE new steamer for the Maritime Sulphate Fibre Company, being built by the Chatham Foundry and Machine Works, is approaching completion. She is length, 56 ft.; beam, 12 ft. 4 in.

A NEW steamer launched recently from Ross, Hall & Brown's wharf, Rat Portage, Ont., measures thirty-six feet in length and eight feet beam, and was built by the Degagnes for John Knight.

THE schooner "Sapphire," Capt. Wm. Cox, of E. B. Marvin & Company's fleet, one of the largest of the sixty sealing vessels that make Victoria, B.C., their headquarters, was completely destroyed by fire and explosions recently near Uclulet.

J. H. BALDERSON, Deputy Minister of Railways and Canals, has been superannuated, and will have leave of absence from first of June to first of July at his present salary. On the first of July he becomes superannuated at a salary of $690 a year.

THE double disaster which recently wrecked the steamers "Ruth" and "Gwendoline" of the Intercolonial Transportation Company, running between Jennings and Fort Steele, B.C., deprived the company of both its steamers, and leaves Fort Steele without any outlet to the south. This means a loss of $50,000 to the company.

THE "St. George" was launched recently from Hon. J. B. Snowball's shipyard at Chatham, N.B. The new steamer is a side-wheeler and intended to be employed as a sea-tug in the work of towing Mr Snowball's barges between his mill at Tracadie and the loading berths at Chatham. She is 119 feet long; 25 feet beam and 12 feet 3 inches deep.

M. & N. K. CONNOLLY, who are now at work on a big dredging contract, at Philadelphia, have secured a contract from the Government of Uruguay, for the construction of a canal sixteen miles in length. The contract price is said to be over $10,000,000. They will start work almost at once, and the probability is that some Canadian workmen will be employed by them.

S. L. Long has been appointed city engineer of Rossland, B.C.

G. H. Garden, C.E., of Montreal, has gone to assume charge of a surveying party at Crow's Nest Pass for the C.P.R.

A large pipe organ is to be presented to Zion Church, Berlin, Ont., by Mrs. C. Breithaupt, in memory of the late E. C. Breithaupt.

James Hendrie, Winnipeg, a member of the Land Titles office staff, was drowned in the Winnipeg River, near White Mouth, recently.

Douglass Gerrard, St. Thomas, Ont., has been appointed assistant engineer of the T.,H. & B. branch of the Michigan Central, at Hamilton.

R. W. Brock, M.A., acting lecturer on mining and assaying in the Kingston, Ont., School of Mines, has been appointed geologist on the Dominion Geological Survey.

Andrew Anderson, for many years the cable underground manager of the Gowrie mine, has accepted a similar position with the North Sydney, C.B., Mining and Transportation Company.

Recently the employees of the Cornwall Electric Street Railway Company, Ltd., presented the secretary, F. N. Seddall, with a valuable smoking set and an umbrella, accompanied by an address expressive of their esteem.

Granville Cunningham, general manager of the Montreal Street Railway, has returned to England to superintend the construction of the new electric railway system of Birmingham. During his further absence, Mr. Wanklyn, manager of the Toronto Street Railway, will have the oversight of the Montreal system. James Ross, vice-president of the Montreal Company, has accompanied Mr. Cunningham to England.

## FIRES OF THE MONTH.

May 4th.—J. Harriman's planing mill, Niagara Falls, Ont.——May 11th.—S. Morley's flour mill, St. Ann's, Ont. Loss $8,000.——May 11th.—Brown & Bogg's machine shop, Hamilton, Ont. Pattern room destroyed; loss $1,500.——May 13th.—The Nova Scotia Lumber Co.'s mills at Sherbrooke, N.S. Insurance, $15,000; loss, $20,000.——May 14th.—J. B. Stringer's elevator, Haycroft, Ont. Loss $2,000.——May 16th.—Waterloo, Ont., Mfg. Co.'s foundry. Loss $5,000.——May 16th.—The premises of the Schlater Asbestos Co., Montreal.——May 18th.—C.P.R. station at West Selkirk, Man.——May 19th.—F. W. Galbraith's planing mill damaged $200 by incendiary fire.——May 22nd.—C. Norsworthy & Co.'s foundry, St. Thomas, Ont; damages fully insured.—— May 24th.—W. A. Simpson's planing mill, Queen st., Toronto. Loss, $12,000; insurance, $2,000.——May 27th.—The Gartshore-Thomson Pipe Foundry. Damages amounted to several thousand dollars.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## Notice.

The undersigned on behalf of John Isaac Thornycroft, of Chiswick, County of Middlesex, Eng.; the owner of the following Canadian Patents, viz.—No. 39,547, dated July 30th, 1892; No. 39,570, dated July 30th, 1892, both for "Improvements in Steam Generators," and No. 52, 451, dated 28th May, 1896, for "Improvements in Water Tube Boilers," hereby gives notice and advises manufacturers and the public generally that the said patentee is ready and willing to grant licenses and permits to any persons desiring to undertake the manufacture of the said inventions in Canada, and also to sell, construct, and use the same, and that terms and conditions may be known by applying either to the patentee, or to

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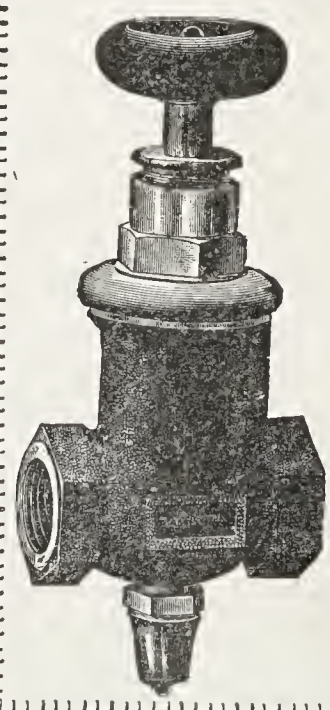

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# The Canadian Engineer

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## DAY LOADS FOR CENTRAL STATIONS AND HOW TO INCREASE THEM.*

BY J. A. KAMMERER.

At no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants. As an evidence of this, there is no more encouraging sign than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using. This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric current, and the compensation received therefrom. Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated. The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business. The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "What is its efficiency?" not "What is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant, is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured. It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night work, they should not look for a day load, any more than a woolen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woolen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woolen mill would either have to close up, or make its plant investment work day and night to make ends meet. Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand a central station operating a lighting load only is handicapped because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant. The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum in-

*A paper read before the Canadian Electrical Association.

vestment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load. The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect. With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need lie idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load. The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone. The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day. Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours, this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured. In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to instal this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days ; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons. While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours. This must be taken into consideration as making the night load more remunerative at a very small added cost.

These, briefly, are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the daytime, tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

## WHY SOME LIGHTING PLANTS DO NOT PAY. *

BY F. C. ARMSTRONG.

Before proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition, taking everything into consideration, would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation ; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being, beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present, or as far as we can see, any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output, which means commercially that under most circumstances it is cheaper

* A paper read before the Canadian Electrical Association.

to get your light from a central station than to instal an isolated plant. It may, therefore, fairly I think be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion, and in it is really involved, as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds. The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service ; the second, and in the early days of the electrical art vastly the most important, is the arbitrary depreciation which is due not to the wearing out of the plant, but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types. There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small ; the commercial efficiency of generators, distribution lines and transformers when used was very low ; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines. The efficiency of the best dynamos of to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes. Regulation in the best machines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine —the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its perfect adaptation to the purpose for which it is primarily intended—the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads ; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent. higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single-phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended, as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out ; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident cases and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods ; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes : the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention exclusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests ; the next is

the large class of small stations which manage themselves, with occasional interference on the part of the owner; in the fourth place, and I say it with due deference, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of stations is as I have stated. Finally, we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement. Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin on the right side between gross revenue and operating expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at $10 each per annum has a revenue of $2,000 per annum, and may not pay; the same plant, if increased to 1,000 lights at $5 per annum, would probably be paying handsomely. It is evident also, that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favourable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it, it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, and not sold by bulk and by guess, there is at bottom a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischievous has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners ; the recent Governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself, could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### CHAPTER II.

### TRAIN RESISTANCES AND THEIR COST.

### ART. 6.—TRAIN RESISTANCES.

It is necessary in a study of routes, especially in instituting comparisons of the advantages of alternative ones, to understand the nature, amount, and cost of the resistances which are offered to the hauling of trains, inasmuch as they have a direct effect on the working expenses of a railway.

These resistances may be any or all of the following, depending on circumstances; but the first four always exist in operating over even a level straight track.

*A*.—(1) Journal friction in the car trucks.
(2) Rolling friction, on the rails, of the car and engine wheels.
(3) Incidental—stopping and starting resistances.
(4) Velocity (wind and oscillating resistances.)

*B*. Grade resistances.

*C*. Curve resistances.

(*A* ) *Level Tangent Resistances.*—In the earlier years of railways, due to imperfect track, workmanship, etc., the journal and rolling friction was found by Clark to be about seven pounds per ton (2,000 lbs.); since then, however, the researches of Wellington and others have shown that on a good track, at ordinary speeds of over 10 miles per hour, these resistances are :—

Loaded Cars—4 lbs. per ton in summer.
" —6 " " winter.
Empty Cars—6 " " summer.
" —8 " " winter.

A change of 60° F. in temperature, showing an increase of 50 per cent. due to poor track, ice, snow, etc., and to an inherent increase in the co-efficient. Morin's law, that friction is independent of pressure or velocity, was deduced from data of a limited range, and does not hold true for extreme cases, the empty cars showing a decidedly higher co-efficient ; but when we consider the co-efficient in its relation to velocity the matter becomes more important. At the point of starting a train, the co-efficient is found to be as high as 18 to 20 pounds per ton, for loaded cars, and even higher for empties, being composed of friction + stiction ; the latter disappears the instant that motion begins, and the co-efficient falls suddenly, to perhaps 10 or 12 pounds per ton, at one or two miles per hour, and goes on steadily decreasing as the speed increases ; but above 10 miles per hour the change is not very appreciable. Should a train get " stalled " on a grade, or be at rest at a depot, it is plain that the *maximum* load cannot be hauled on the *maximum* grade ; this matter will be taken up further on.

It will thus be seen that under ordinary cases the force necessary to propel one ton along a level, straight track at ordinary speeds, and disregarding velocity resistances, varies from 4 to 8 lbs., depending on the time of year, condition of load, track and rolling stock ; in future calculations in these papers it will be taken at 6 lbs. per ton for loaded train.

The resistance offered to movement through space by the air has been extensively experimented on. The weight of evidence until recently was in favor of the belief that the resistance varied as (velocity) $^2$. Based on this belief, the formula deduced for total level, tangent resistance on railways, by Clark, was :—

$$\text{Lbs. per ton hauled} = R = 7 + .0052\ V^2 \quad (1)$$

(V being in miles per hour), in which the latter term represents the effect of the wind. Wellington also, as a result of the Burlington tests, made at moderate speeds, gave the following empyrical formulæ :—

Lbs. per ton (*a*) for loaded flat cars $= R = 4 + .0065\ V^2 + .57 \frac{V^2}{W}$ (2)

" " (*b*) " box or psgr. cars $= R = 4 + .0075\ V^2 + .64 \frac{V^2}{W}$

" " (*c*) " empty flat cars $= R = 6 + .0083\ V^2 + .57 \frac{V^2}{W}$

" " (*d*) " box or psgr. cars $= R = 6 + .0106\ V^2 + .64 \frac{V^2}{W}$

Where the 2nd term represents the head and side air resistances, and the 3rd term the effect of oscillations, which being chiefly in the engine, decrease, per ton, as the train gets longer, V = miles per hour W = gross weight of train in tons.

TABLE V.

POUNDS PER TON FOR TOTAL LEVEL TANGENT RESISTANCE.

| Speed in Miles per hour. | Clark (1) $7 + .0152\ V^2$ | Wellington 2 (6) $4 + .0075\ V^2 + .6^4 \frac{V^2}{W}$ (W = 450 tons.) | Wellington (3) $2 + \frac{V}{4}$ | Average |
|---|---|---|---|---|
| 10 | 7.52 | 4.89 | 4.5 | 6 |
| 20 | 9 08 | 7.56 | 7.0 | 8 |
| 30 | 11.68 | 12.03 | 9 5 | 11 |
| 40 | 15.32 | 18.27 | 12.0 | 15 |
| 50 | 20.00 | 26.30 | 14.5 | 20 |
| 60 | 25.72 | 36.12 | 17.0 | 26 |
| 70 | 32.48 | 47.71 | 19.5 | 33 |
| 80 | 40.28 | 61.08 | 22.0 | 41 |
| 90 | 49.12 | 76.27 | 24.5 | 50 |
| 100 | 59.00 | 93.20 | 27.0 | 60 |

Recently, however, the very high speeds obtained on various trial runs, and even scheduled trains, have thrown doubt on the idea that at high speeds, at least, the resistances could vary as the (Velocity)$^2$. In 1892, Mr. Wellington, after a study of Dudley's experiments on the New York Central Railway at speeds of 51 miles per hour, Sinclair's experiments on the same road at speeds of 50 to 75

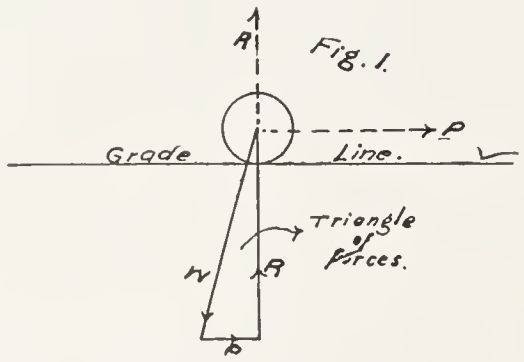
* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

miles per hour, Worsdell's experiments on the North Eastern Railway of England at speeds of 5 to 86 miles per hour, and Crosby's wind experiments, arrived at the formula: Lbs. per ton $= R = 2 + \frac{V}{4}$ .....(3) for speeds of over 40 miles per hour, but considered that at lower speeds the increased axle friction affected the results.

By which it will be seen that Clark's formula, fixed on years ago, is very close to the average, being slightly too high at low speeds. For the purposes of ordinary calculations the column of averages will be used. It is noticeable that at speeds of over 40 miles per hour, the wind resistance is a very large factor, while in freight hauling it is unimportant. And although passenger traffic is being carried on at higher speeds year by year, the addition of vestibules set out flush with the sides of the cars will very materially decrease that eddying around each car which forms a large part of the air resistance, while a pointed prow to the engine has been experimented on in France, and might be found advantageous at extreme speeds. The internal losses of a locomotive are, of course, not considered here, but the power as delivered to the rim of the driving wheels. The rolling friction of the engine wheels, being external to the engine, however, are included. The internal losses are about 10 per cent. (*i.e.*) 90 per cent. of the power developed may be applied to overcome the various train resistances.

### (*B.*) Grade Resistances.

Grades are usually expressed as that per cent. which the rise or fall in a given distance is of that distance, or less frequently in feet rise or fall per mile of distance. Thus:—A grade of 1 in 100 = 1 per cent. grade = 52.8 feet per mile (in Figure 1); the forces which hold the




weight $W$, in equilibrium, are:—$R$, the reaction of the rails, and $P$ the pull up the grade, the ratio of $\frac{P}{W}$ (or more precisely $\frac{P}{R}$ *) is seen to be the same as the rate of grade, or, up say a 1 per cent grade, the force necessary to propel a ton at a *uniform velocity*, $= \frac{1}{100} \times 2{,}000$ lbs. = 20 lbs., and other grades in direct proportion; in other words, grade resistance is a definite calculatable quality, and varies with the grade only.

*Velocity Head on Grades.*—If a train is not moving at a uniform velocity, the energy stored up in it is not constant; but varies with the speed of the train. This energy may be expressed in so many feet which the body would need to fall to acquire the velocity corresponding to a given amount of energy or velocity head $= h = \frac{v^2}{2g}$ where $v =$ velocity in feet per second, or, if we change to $V$ miles per hour, we get $h = \frac{1}{2 \times 32} \times V^2 \times (1.5)^2 = .033V^2$ .....(4) In addition to this there is the energy stored up in the revolving wheels, which will, for ordinary cases, increase the total energy of the train in motion about 6 per cent., or change the formula to $h = .035V^2$ .....(5).

The values for $h$ for various velocities are as follows:

TABLE VI.

| $V$ (miles per hr.) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ (feet) | 0.8 | 3.5 | 7.8 | 14.0 | 21.9 | 31.5 | 42.9 | 56 0 | 70.9 | 87.5 | 126.0 |

In considering velocity head, as it affects grades, we may treat it (*a*) as it affects stopping and starting, (*b*) as it permits of fluctuating speeds and a conservation of energy.

(*a*) The amount of force necessary to expend in starting a train, over and above what is needed to keep it moving at a uniform velocity, under the same conditions, will depend on the distance through which it acts. If, for instance, it is desired to start a train from rest and acquire a velocity of 30 miles per hour in 1,500 feet, the virtual additional grade will be $\frac{31.5}{15.} = 2.1$ per cent. grade, and the additional grade resistance will be $2.1 \times 20 = 42$ lbs. per ton *to be added* to any train resistances that would exist if the train were moving at a uniform velocity. In the same way in stopping a train the brakes absorb the stored up energy more or less rapidly depending on the length in which the stop is made (*e.g.*) a stop in 250 feet from a speed of 20 miles per hour $= \frac{14}{2.5} = 5.6$ per cent. grade to which the brake friction is equivalent $= 112$ lbs. per ton.

(*b*) Although it is usually considered that the grades of a road are certain definite inclines, this is only nominally so; actually, the "virtual" rate of grade against which the engine has to contend depends on what fluctuation of speed can be allowed between the foot and the top of the grade, and the length of the grade. The method of calculating "virtual" grades is as follows: Take an assumed speed, of say, 30 miles per hour at the foot of the grade, and a safe minimum speed to prevent stalling, of say 10 miles per hour at the head of the grade, then the difference of their velocity heads $= 31.5 - 3.5 = 28$ feet. Now this 28 feet, or whatever it may be (it may usually be limited to 25 or 30 feet), is to be deducted from the total actual grade to give the total virtual grade. It will be seen that while velocity head is a large item on short grades, it is insignificant on long ones. Thus great economy of construction can be effected often by the introduction of short, steep grades (*e.g.*) a 1 per cent. grade two miles long—actual lift $= 52.8 \times 2 = 105.6$ feet, virtual lift $= (105.6 - 28) = 77\ 6$ feet (30 miles per hour speed reduced to 10 miles per hour at summit), and the virtual grade $= \frac{77.6}{105.6} = .73$ per cent.

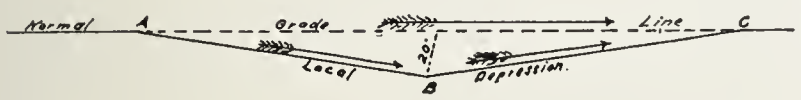
In this way on any railway profile above the actual grades should be plotted the virtual grades for different fluctuations of speed. A study of these will often enable changes in grade to be introduced, from economical motives, using short pieces of grade above the nominal maximum or dropping temporarily, in a short sag or depression, to save embankments. But the introduction of short steep grades should not be carried beyond about a 20 foot "sag" below normal; for supposing (see Fig. 2) that a train approaches $A$ at a speed of 15 miles per hour, $= 7.8$ feet velocity head, and with uniform engine power still on, passes to $B$ and then $C$, in the normal grade line, as the train passes $A$ the tension on each draw bar will momentarily increase and the train will begin to accelerate its speed until $B$ is reached, when the velocity will correspond to a velocity head of $7.8 \times 20 = 27.8$ feet, or will be about 28 miles per hour, from $B$ to $C$; the speed will decrease and the train will arrive at $C$ with a speed of 15 miles per hour; or, in other words, the limit of "sag" is the limit which we assign to safe freight speeds (see Chapter III. for vertical curves), and may be placed at about 20 feet, defining the point up to which local depressions, in a grade, are of no importance, and may be

* The error in taking $\frac{P}{W}$ instead of $\frac{P}{R}$ is infinitesimal, being only about $\frac{1}{100}$ lb. out of 100 lbs. on a 5 per cent. grade.

passed over with steam on, and no brakes set, or the same brakes if descending, of course, practically, no excessive dip of very high rates of grade could be used, except temporarily during construction, for sake of appearance, and because the proper use of vertical curves would eliminate them.

It is interesting to note that although the total power exerted in passing from *A* to *C* (Fig. 2) is the same as though the train had passed along the more direct grade line, the average rate of speed is increased, and the *time* of transit from *A* to *C* is *less* on the depressed grade

Fig. 2




than on the direct one. But note that a rise *above* the normal grade line is not permissible, as it would probably stall a slowly moving freight train.

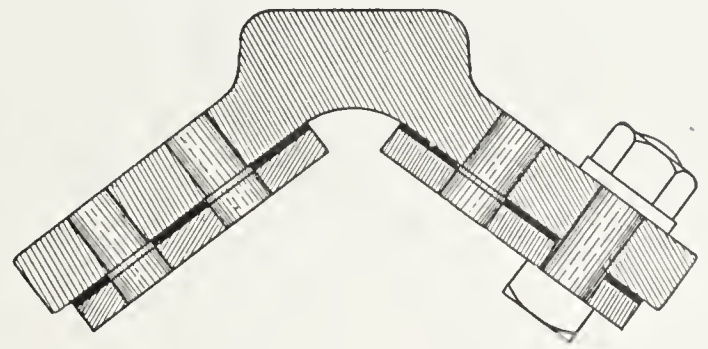
In connection with the fluctuation of speed, also, is the question of modification of grades at stopping places, where these grades are anywhere approaching the maximum, while level tangent resistance, at ordinary speeds o say 20 miles per hour, is about 8 lbs. per ton. It is as h gh as 18 to 20 lbs. per ton at zero + .. miles per hour (*i.e.*) at the instant of starting, so that any depot grade should be less than the maximum by, say, (20 – 8) = 12 lbs. per ton = $\frac{6}{10}$ grade. Also for the sake of getting up speed quickly, it should, if possible, be still further reduced, so that depot grounds are usually selected as nearly on leve ground as possible. These restrictions do not apply rigidly to light passenger or local freight trains, not loaded to the full capacity of the engine, but prevent heavily loaded freight trains from stopping at stations on grades approaching the maximum.

Another danger of yards on grades is that the wind may blow cars out on to the main line from the sidings Yards are sometimes, however, laid out with about a $\frac{6}{10}$ per cent. grade, where much sorting is done, and the cars are sorted by gravity on to different tracks.

(*To be continued.*)

## THIRD RAIL TRANSMISSION.

The New York, New Haven and Hartford Railway directorate has made another advance in the application of electricity in the operation of its road, in the electrical equipment of its line running from Berlin to Hartford, Conn. This important departure differs in its electrical equipment from the line at Nantasket in that the trolley system of contact is not used. That adopted is the third rail system, the conductor or third rail being laid along the centre of the track between the running rails. The rail is rolled in 30-feet lengths, and weighs 93 lbs. to the yard. The section chosen is one which it is believed will be to a large extent self-protecting as against rain, snow and ice, as the tendency is to shed water to each side, leaving a fairly dry place immediately below the rail. This rail is mounted upon wooden block insulators impregnated with a preservative and insulating compound. These blocks are fastened to the ties by 2 inch × 2½ inch dowels, and three blocks to each 30 feet rails are ordinarily employed. The blocks are of such a length that the top of the third rail is held 1 in. above the top of the service rails, and the lowest points of the third rail are 1⅝ in. above the ties. It is necessary to have the shoe on the car carried high enough to clear the special work of the track, and the third rail low enough to avoid reaching any of the metal parts of the truck on the electric and other trains passing over the line. Careful inspection of all cars must be provided to prevent accidental short circuits due to contact of truck mechanism with the third rail.



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The third rails are mechanically and electrically connected together at their ends by heavy wrought iron fish-plates, 12 ins. × 4½ ins. × ¾ in., between which and the rails are placed ⅛ in. sheet copper bond plates of the same area. These four plates, two of copper and two of iron, are firmly bolted to the rail by sixteen ⅝ in. bolts with lock nuts and the entire double bond has a current carrying capacity equivalent to 1,800,000 c.m., which is in excess of the capacity of the rail itself.

At switches and crossings the third rail is omitted, the circuit being continued underground by stranded bare copper cables of 500,000 circular mils and in some cases 850,000 circular mils. These cables are first drawn into creosoted wooden conduits filled with an insulating material. They are then laid in creosoted wooden troughs in turn filled with the same compound and then boxed over and buried. The broken ends of the third rail are fitted with wooden inclines or approach blocks to allow the shoe to rise upon the rail without danger of catching and breaking.

The shoe is a 12 inch by 5 inch cast-iron plate and is suspended from a wooden insulated support, fastened to the truck by links joined in such a way as to give the shoe considerable flexibility. The engineering advantages of the third rail construction are obvious. The rail can be easily and quickly laid, and so insulated from the ground that the leakage is little or nothing. This has been absolutely proven. The third rail provides a conducting capacity for the current equivalent to a very large copper cable, so that on many light traffic lines copper feeder capacity will not be required. There is little sparking between the shoe and the rail, and no appreciable wear from friction. Altogether, the advantages of the third rail construction are such that there is no doubt that, in one form or another, it will become the standard method of conveying heavy currents in railroad service.

The entire plant is very fully described in the June number of the *Street Railway Journal* by N. H. Heft, electrical engineer of the New York, New Haven & Hartford Railway.

*For* THE CANADIAN ENGINEER.

## PAINTING METAL BRIDGES.

BY WILLIAM B. MACKENZIE, MEM. CAN. SOC. C.E., MEM. AM. SOC. C.E., ASSISTANT ENGINEER INTERCOLONIAL RAILWAY, MONCTON, CANADA.

In the early part of 1895 I began to investigate the subject of painting metal bridges. After reading what literature I could obtain, I determined to make a few experiments for myself, the results of which are here presented. I do not feel at liberty to give manufacturers' names in a communication of this kind, particularly as my tests are so few ; but I have no objection to giving, in a less public

way, such facts as I have, to persons interested in the subject.

Twenty-four new wrought-iron plates, one foot square and three-eighths of an inch thick each, were painted two coats of different kinds of paint, under precisely similar conditions, the boiled linseed oil being the same in all, excepting those samples obtained ready-mixed from the manufacturers. These plates were provided with hooks on the back, and hung on the lower chord eye-bars of a steel railroad bridge 1,900 feet long, across a strait or arm of the sea, in latitude 45° 56′ N., longitude 60° 59′ W. They stood vertically at a height of nine feet above the water surface, and were exposed to the sun and salt air at all times, and also to salt spray in rough weather. They faced the prevailing wind from the north-east.

This strait, or arm of the sea, is situated about 35 miles from the Atlantic Ocean, lies north east and south-west, and forms a narrow passage five miles long and 1,900 feet wide, between two large inland basins. The strait is bounded by high land on both sides, the bridge crossing it in an east and west direction. The wind usually comes from the north-east, and a light breeze causes spray to be dashed against the floor. In storms, the spray is thrown over the floor and across the bridge. The rise of tide in the open sea, 35 miles distant, is five feet, but here the rise is only six inches.

Metal corrodes here very rapidly. The bridge itself was erected in 1890. One coat of iron oxide paint was applied in the shop and another coat given after erection. In 1892, it was considerably rusted, and two coats of iron oxide paint were put on the lower chords and floor system; but without proper inspection or scraping. In 1894, scales one-eighth of an inch thick were removed from the end stiffeners of the floor-beams on the north side. Pieces of this scale were trimmed to exact dimensions and the cubic contents calculated. On being weighed, the scale was found to weigh slightly more than one-half that of new steel.

A chemical analysis of iron-rust scale from the outside of the Conway Tubular Bridge, in England, is as follows:

| | | |
|---|---|---|
| Sesquioxide of iron | 92.9 | per cent. |
| Protoxide of iron | 6.177 | " |
| Carbonate of iron | 0.617 | " |
| Carbonate of lime | 0.295 | " |
| Silica | 0.121 | " |
| Ammonia | trace. | |
| | 100.000 | " |

In August, 1895, our bridge was thoroughly scraped and painted with two coats of iron oxide paint, the analysis of which is as follows:

| | | |
|---|---|---|
| Color | Indian red. | |
| Fineness | 80.00 | |
| Body | 85.00 | |
| Strength | 70.00 | |
| Iron oxide | 48.16 | per cent. |
| Insoluble matter | 51.84 | " |

Adulterated slightly with clay.

It is now in good condition; but will require constant attention to remedy defects in the painted surface as they appear.

It will be seen by the record of the experimental plates (see table) that the asphalt paints, the carbon paints, the coal-tar coatings, and some of the oxide of iron paints are already out of the race, and that neither the lead nor the graphite paints are holding out quite as well as might have been expected.

A chemical analysis of the water beneath the bridge was arrived at as follows:

The average density of ocean water is 1.026, and the composition is as follows:

| | |
|---|---|
| Water | 96.5 per cent. |
| Salts | 3.5 " |

The composition of the salts is as follows: —

| | |
|---|---|
| Chloride of sodium | 77.758 |
| Chloride of magnesium | 10.878 |
| Sulphate of magnesium | 4 737 |
| Sulphate of lime | 3 600 |
| Sulphate of potash | 2 465 |
| Bromide of magnesium | 0.217 |
| Carbonate of lime | 0 345 |
| Total salts | 100.000 |

The density of the water under the bridge was deter-

## RECORD OF TWENTY-FOUR PAINTED PLATES.

EXPOSED ON A STEEL RAILROAD BRIDGE OVER AN ARM OF THE SEA, LAT. 45° 56′ N., LONG. 60° 59′ W.

| Mark on Plate. | Kind of Paint. | How Mixed. | No. of Coats | When Painted. | When exposed on Bridge. | Length of time Exposed. | State when examined by W. B. McK. on Nov. 30th, 1896. |
|---|---|---|---|---|---|---|---|
| I | Oxide of iron | Boiled linseed oil | 2 | March, 1895 | April 24, '95 | 1 year & 7 ms. | In good condition. |
| II | Red lead | Raw linseed oil | 2 | do | do | do | Discolored and slightly rusted. |
| III | Graphite paint | Boiled linseed oil (?) | 2 | do | do | do | Small patches of rust all over. |
| IV | Oxide of iron | Boiled linseed oil | 2 | do | do | do | Rusted all over. |
| V | Anti-corrosion paint | ⅓ raw oil, ⅓ boiled linseed ⅓ turps | 2 | do | do | do | In good condition. |
| VI | Black anti-rust paint | Mixed by the manufacturer | 2 | do | do | do | Very much rusted. |
| VII | White lead | Half raw and half boiled linseed oil | 2 | do | do | do | Half the plate rusted and discolored. |
| VIII | Tar and asphalt coating applied hot | | 1 | do | do | do | Considerably rusted. |
| IX | Red lead 1 lb. and lampblack 1 oz. | Raw linseed oil (no drier) | 2 | do | do | do | In fair condition. |
| X | Oxide of iron | Mixed by the manufacturer | 2 | do | do | do | Very much rusted. |
| XI | This painted plate was supplied by a painter for test. The composition of the paint is unknown to me | | | | do | do | Considerably rusted. |
| XII | Black bridge paint | Mixed by the manufacturer | 2 | | do | do | Very much rusted. |
| XIII | This painted plate was supplied by a painter for test. The composition of the paint is unknown to me | | | | do | do | In good condition, |
| XIV | Asphalt paint | Mixed by the manufacturer | 2 | | do | do | Rusted all over. |
| XV | Carbon paint | Mixed by the manufacturer | 2 | | Oct. 31, 1895 | 1 year & 1 mth | Rusted in large patches. |
| XVI | Oxide of iron | Mixed by the manufacturer | 2 | July 17 1895 | do | do | Fairly good condition; a few rust spots. |
| XVII | Oxide of iron | Mixed by the manufacturer | 2 | do | do | do | Covered with rust; paint all gone. |
| XVIII | Graphite paint | Mixed by the manufacturer | 2 | do | do | do | Fairly good. |
| XIX | Coal tar coating; plate heated and dipped in hot tar | | 1 | do | do | do | Rust spots all over. |
| XX | Oxide of iron | Mixed by the manufacturer | 2 | do | do | do | Fairly good; a few rust spots. |
| XXI | 2 lbs. 7 ozs. yellow ochre and 1 oz lampblack | Raw linseed oil and Japan | 2 | do | do | do | Good; a few rust spots on back. |
| XXVIII | Paint for ironwork (secret process), said to be furnace slag, linseed oil and gum | Mixed by the manufacturer | 2 | March, 1896 | April 4, 1896 | 8 months | Very good. |
| XXIX | Oxide of iron | Mixed by the manufacturer | 2 | April 1, 1896 | April 9, 1896 | do | Small rust spots scattered over. |

REFERENCES:

III. The manufacturers say that the pigment is mixed in pure kettle-boiled linseed oil, and direct that in dry weather it be thinned with raw linseed oil, and in damp weather with boiled linseed oil.

XII. The manufacturers say that the pigment is mixed in linseed oil and turpentine and that it also contains asphaltum and Kauri gum.

XIV. The manufacturers say that this paint contains no coal tar, and direct that it be thinned with 62 per cent. benzine.

XVI. The manufacturers say that the mixture of this paint is a secret process and that it contains no oil. It sets too quickly and is difficult to apply for this reason.

XX. The manufacturers say that the pigment is mixed in pure clarified linseed oil.

mined roughly by weighing a certain volume and comparing it with the weight of a like volume of fresh water. This gave a density of 1.00813, which would make the composition as follows :—

| | |
|---|---|
| Water | 98.215 per cent. |
| Salts | 1.785 " |
| | 100.000 per cent. |

The composition of the salts would be the same as that given above for ocean water.

The highest summer temperature of the air in 1895 was 82° F., and the lowest temperature in winter of 1895-6 was—2° F. The highest summer temperature of the air in 1896 was 72° F., and the lowest temperature in winter of 1896-7 was—7°. The summer temperature of the sea-water under the bridge is 60° F. to 63° F., and the winter temperature 30° F. to 35° F. Total precipitation in 1895 was probably about 70 inches. Total precipitation in 1896 was 69.86 inches. Snow lies on the ground, more or less, in depths from three inches to three feet, between the middle of December and the middle of April. The greatest velocity of the wind during north-east autumn and winter storms is about 60 miles per hour.

### CORROSION.

Corrosion is most active in autumn and winter, because there is then more moisture deposited upon the metal, and the water contains a larger proportion of oxygen and carbonic acid.

| | | | | | |
|---|---|---|---|---|---|
| At 32° F. water will absorb | 4.9% | of its own bulk of | oxygen. | | |
| At 50°F. | " | 3.8% | " | " | " |
| At 68°F. | " | 3.1% | " | " | " |

Snow water contains more oxygen than rain or river water and will rust metal quicker. Cold water dissolves more carbon dioxide than warmer water. At 32° F. water will dissolve 1.8 volumes of carbon dioxide, and at 60° F. only one-half as much. Pure rain-water contains $2\frac{1}{2}$ volumes of air in 100 volumes of water. If water is freed from oxygen by boiling, iron will not rust in it, nor will it rust in perfectly dry air. Rust consists of iron, oxygen and water and it requires a simultaneous action of oxygen and water to produce it. Damp oxygen and damp carbon dioxide in combination produce rust quickly. Neither will do so when dry either together or separately, and only to a very slight extent when damp, separately. It requires the combination of both, damp, to rust quickly.

| | |
|---|---|
| Steel, when unprotected and exposed to the weather and sea-water, corrodes at the rate of $\frac{1}{82}$ of an inch per year | or 1 inch in 82 years. |
| Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{190}$ of an inch per year | or 1 inch in 190 years. |
| Steel, unprotected and exposed to the weather and fresh water, corrodes at the rate of $\frac{1}{170}$ of an inch per year | or 1 inch in 170 years. |
| Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{430}$ of an inch per year | or 1 inch in 430 years. |
| Steel, unprotected and submerged in sea-water, corrodes at the rate of $\frac{1}{130}$ of an inch per year, | or 1 inch in 130 years. |
| Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{310}$ of an inch per year | or 1 inch in 310 years. |
| Steel, unprotected and submerged in fresh water, corrodes at the rate of $\frac{1}{600}$ of an inch per year | or 1 inch in 600 years. |
| Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{700}$ of an inch per year | or 1 inch in 700 years. |

Wrought-iron in an overhead bridge, subjected to coal-smoke from locomotives, corroded in 25 years from 39.5 per cent. or 1.8 per cent. per year to 100 per cent., or 4 per cent. per year, some of the members being entirely eaten away.

Unstrained members corrode more quickly than strained members. Shaded parts will corrode more slowly than parts exposed directly to the sun's rays.

Real iron-rust does not promote further rusting because of any chemical influence on the iron, but being a spongy mass, it retains in its pores 24 per cent. of water deposited as rain or dew. It does not, therefore, prevent, but rather encourages rusting, and in this way has a physically injurious effect upon iron. Corrosion accelerates with time, the second year's being 50 per cent. greater than the first.

### LINSEED OIL.

In paint, oil is king; any finely ground pigment, inert toward the metal and oil, will last until the oil decays and wastes away, and against this decay and waste there is no remedy. The raw oil is obtained by both cold and hot pressure from linseed, or the seed of the flax plant, *Linum usitatissimum*. When cold-drawn, the color of the oil is golden-yellow, and when hot-pressed, brown-yellow. The specific gravity is :

| | |
|---|---|
| At 50° F. | = 0.9385 |
| " 53½° F. | = 0.9364 |
| " 59° F. | = 0.9350 |
| " 68° F. | = 0.9325 |
| " 77° F. | = 0.9300 |
| " 266° F. | = Boiling-point. |
| " —16½° F., | the oil congeals to a solid yellow mass. |

It is sold under different forms: Raw, refined, boiled and artist's oil. The seed should be ripe, and from two to six months old. The quality of the oil is affected by the quality of the seed, which is in turn ruled by the soil and climate in which it is grown. Boiled oil is heated to a temperature of from 266° to 600° F., and agitated mechanically for five or six hours. Water evaporates, and the scum and froth is removed from the surface with ladles; this scum is afterwards used in making putty. Equal quantities of litharge and red lead are added by slow degrees as dryers, to the extent of three per cent. of the oil, a small proportion of umber being also thrown in. The heat is continued for two or three hours, when the fire is suddenly withdrawn and the oil left covered over for ten hours longer. It is now known as "boiled oil," and is stored in settling-tanks for a few weeks, during which time the uncombined driers settle to the bottom as "foots." The heating process darkens the color and causes the oil to dry quickly, producing a hard firm surface. Pure, unadulterated linseed oil is not a common article. Driers are not infrequently added through the bunghole without boiling. Cotton-seed oil, Niger oil, hemp-seed oil, poppy seed oil, colza oil, rape-seed oil, Lucca oil, resin oil, turpentine oil, benzine, fish oil, animal oil and water are often mixed with it, all or any of which shortens the life of the paint. There are about 17 vegetable drying oils which may be used in paint, and over 30 vegetable non-drying oils, which may be used as adulterants. The greater number of these oils are cheaper than linseed oil. In addition, there are the fish and animal oils, so that the rarity of pure linseed oil is not to be wondered at.

The purity of linseed oil may be roughly tested by shaking it well; if iridescent bubbles appear on the surface, it is adulterated with benzine or mineral oil; if sulphuric acid is present, the paint when shaken and then allowed to stand will thicken into a brown paste. Other rough tests are: Brush it upon brown paper, and expose to the sun's rays; the water, benzine, etc., will

evaporate and leave the oil. Dip a sheet of well-sized paper into the oil, and hang it up to dry; when dry the whole of the sheet should show a well-varnished coating; if only the bottom of the paper is varnished, the oil is insufficiently boiled. Brush the oil on a smooth wood surface; if it turns white, "blooms" in drying, it is adulterated with resin.

Oil, when spread out thinly, dries by absorbing oxygen from the air; the water and vapor passing out create multitudes of very minute holes in the oil cover, where water may enter; these holes are partly filled up by the second coat of paint. While the oil is absorbing oxygen, it adds 13 to 14 per cent. to its weight.

PIGMENTS.

After reading what the different manufacturers say about the price, covering capacity, and durability of their own particular paints, and the folly of using anything else, a person is inclined to believe fully in David's hasty assertion that "all men are liars."

The following comparative statement of the cost of painting a 100-foot span steel bridge, with a number of kinds of good paint, is taken from a statement published by C. E. Fowler, C.E., in the *Engineering News* of Feb. 6th, 1896. The cost of painting spans from 20 feet to 300 feet was accurately determined, and it will be seen that, after all, there is very little difference in the first cost between good qualities of the usual kinds of paint used for general railroad work; there being only $9.25 difference between oxide of iron and red lead for a span of 100 feet.

Cost of painting a 100-foot railway bridge (clean new iron) with different kinds of pigments and linseed oil:

Oxide of iron—14 gals. 1st coat, at 50c; 10 gals. 2nd coat, at 50c.
Labor, $68.00 = $80.00

Red lead—10 gals. 1st coat, at $1.25; 7 gals. 2nd coat, at $1.25.
Labor, $68.00 = $89.25

White Lead—14 gals. 1st coat, at 85c.; 10 gals. 2nd coat, at 85c.
Labor, $68.00 = $88.40

Graphite—14 gals. 1st coat, at 70c.; 10 gals. 2nd coat, at 70c.
Labor, $68.00 = $84.80

Asphalt—23 gals. 1st coat, at 40c.; 14 gals. 2nd coat, at 40c.
Labor, $68.00 = $82.80

Carbonizing coating—7 gals. 1st coat, $1.50; 5 gals. 2nd coat, $1 50.
Labor, $68.00 = $86.00

SCRAPING.

The labor of scraping the metal and applying the paint is from four to eight times the cost of the pigment and oil; so that there can be no economy in using cheap paint. To remove scale, loose rust, oil, dirt and cinders, use benzine, chisels and hammers, wire brushes and scrapers, as may be necessary. Unless the metal is perfectly clean and dry, no paint can be successful. Scraping should not proceed far ahead of the painting. Should salt spray touch the scraped metal, it should be scraped again before painting.

KIND OF PAINT AND ITS APPLICATION.

It is absolutely necessary that the first coat should contain a large quantity of pigment, and should dry quickly with a dense, firm surface, to receive the second coat in from 48 to 72 hours. If not dry and firm, the paint will blister, because of the separation of the first coat from the metal. To secure this, a pigment of high specific gravity must be used in boiled linseed oil, with a considerable quantity of turpentine, and we cannot do better than use a heavy, finely ground oxide of iron pigment, inert toward both metal and oil, and which has already been tested for durability, such as No. 1 of my experimental plates. Iron oxides often contain acids, lime, sulphur, clay, etc., so that there is much room for choice. Red-lead has been largely used for first-coat work, because it dries quickly, with a hard surface; but if the air, from local causes, contains obnoxious gases, such as sulphuretted hydrogen gas, produced by the passage of trains, the red-lead will be quickly destroyed. J. Newman, author of "Corrosion and Fouling," says by letter of 21st January, 1897: "Probably the *worst* paint you can use for either iron or steel is ordinary lead and oil paint." Oil alone should not be used for priming in the shop; it collects dirt and cinders; besides, the pure oil dries, but never hardens. As it contains no pigment, it is quite porous and pervious to water; the surface will consequently expand and present a shrivelled appearance and blisters will eventually appear.

For second-coat work, an elastic but firm surface is required to follow the expansion and contraction of the metal and resist the mechanical impact of strong dust or cinder-laden winds and rain, spray, hail and snow. In this coat more boiled oil, a less weighty pigment, and a less quantity of turpentine is required, so that it will dry more slowly and for a longer time resist the sun's influence, which is ever tending to harden and crack the surface and allow the entrance of water to the metal. A pigment, then, of low specific gravity must be used. Crude graphite ore powder has a specific gravity of about 0.7, and as graphite cannot be affected by chemical influences, it would seem to offer a suitable material for second-coat work. I have tested it for a period of one-and-a-half years, and so far it has done fairly well. Objections have been urged against it as follows:

1st. It is expensive to grind to a high degree of fineness, because of its oily and flaky character.

2nd. Because of its lightness, no great body of it can be got into the oil.

3rd. It settles out of the oil.

Some of these objections may be more imaginary than real.

A prominent manufacturer says that the composition of the best graphite now mined, ground and used for paint, is as follows:

ANALYSIS OF THE CRUDE ORE.

| | | |
|---|---|---|
| Moisture | 0.15 | per cent. |
| Graphite | 33.48 | " |
| Silica | 37.54 | " |
| Oxide of iron | 14.25 | " |
| Pyrites of iron | 1.27 | " |
| Oxide of alumina | 12.35 | " |
| Lime | 0.54 | " |
| Magnesia | 0.48 | " |
| | 100.00 | |

On referring to the statement of cost, it is seen that for a 100-foot span bridge, the cost of graphite is $4.80 greater than iron oxide.

There exists in Canada, in large quantities, a cheap natural product, the specific gravity of which, compared with No. 1 iron oxide powder, is as 0.31 to 1. This material, after an inexpensive treatment, can be mixed with the iron ore powder to reduce the weight and increase the bulk, and on adding oil, a paint will be produced affording an elastic silicious surface which will resist cracking, peeling and blistering for a much longer time than the iron oxide alone.

On a clean, dry surface, paint applied at a temperature of 70° F., will last longest. Painting should not be done in damp, wet or freezing weather, and on summer mornings time must be given for the dew to evaporate before work begins, as oil paint will not adhere to wet metal. Painting should never be done by contract, but by day work, under a competent foreman. In painting it is best to begin at the top and work down. Buy paint in

powder form when possible; next best in paste form. Light colors quickly become covered with a layer of dust, which absorbs as much heat as dark surfaces. The greater the number of pigments mixed together, the shorter the life of the paint.

LIFE OF METAL BRIDGES.

Heretofore, owing to increases in train loads, flimsy construction and neglect, the average life of iron bridges has not been over 25 years, and it is now generally believed among well-informed engineers that the average existence of such properly designed metal bridges as have lately been constructed throughout the country will not greatly exceed fifty years. Where corrosion is particularly active, as at the bridge of which I have spoken, the life of the structure must be much shorter, probably not over 35 years.

An English oxide of iron paint much used in this country contains 48 per cent. of iron oxide and 52 per cent. of insoluble material, and some American oxide of iron paints contain as little as 33 per cent. of iron oxide and 60 per cent. of silica. We have in Canada unlimited quantities of iron ore, which requires no preparation except grinding. Why should we then continue to import that with which nature has so liberally endowed us, and why should we continue to use unsuitable paints on locomotives, stationary engines, cars, roofs, bridges, freight and store-houses, when good iron oxide paints are cheaper and more lasting?

The company which will produce iron oxide paint from Canadian ore, as good as the best, push its sale, and show the people its advantages for works of this kind, will benefit both themselves and those to whom they sell. Hundreds of iron ore deposits exist in Canada, some affording 72.4 per cent. metallic iron, and several extensive graphite deposits, some of which produce 50 per cent. of pure black lead, while the natural product of low specific gravity for mixing with the iron ore powder can be supplied pure in any desired quantity.

For part of the information contained in the foregoing article, I am indebted to Prof. J. Spennrath's prize essay on "Protective Coverings for Iron," 1896; J. Newman's "Corrosion and Fouling," 1896, and to several articles in engineering periodicals by such high authorities as W. P. Wood, E. Gerber, W. G. Berg, A. H. Sabin, Samuel Wallis, J. H. Stanwood, and J. E. Greiner.

## ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIHGTING AND POWER.*

BY W. A. JOHNSON.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste. Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be in most cases less than the cost of generating plant. When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h.p. output, owing to the increase in the working staff. On the contrary, to increase the capacity of a station with accumulators, requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30 per cent. more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary. The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage. No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h.p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals. The management of the large stations in Boston, Brooklyn, and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsation of the practicability of accumulators. In Germany, France and England they have been largely used for years past. Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The populations of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:—

| Company. | H. P. Hour Capacity |
|---|---|
| Hartford Electric Co. | 3,000 |
| Boston Edison Co., four batteries, a total of | 7,400 |
| New York Edison Co | 3,200 |
| Brooklyn Edison Co | 1,600 |
| Germantown Electric Light Co | 300 |
| Electric Railway, Light & Power Co., Anaconda, Montana | 500 |
| Woonsocket Electric Machine & Power Co | 400 |
| Eastern, Pa., Edison Co | 200 |

These last three plants are used both for railway and lighting work.

As good an illustration as I can give of the appli-

* A paper read before the Canadian Electrical Association.

cation of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, who use a battery of 400 h.p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of the feeder formerly in use frequently varied as much as 50 per cent.; the battery, however, gave practically a steady pressure at all times. Railroad men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100 per cent. In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes, the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries. Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railroads in Canada serve a district up to seven miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radical lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified gravity (1,200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased. The claim has been made and experience seems to prove it true, that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as if judgment is used in proportioning the size of battery to generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it, the following gives in figures the actual conditions obtained in a plant now working: Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90 per cent., 93 h.p.; total steam plant required if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery, 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18¼ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h.p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500 volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity; in fact, being equivalent to that installed by the Union Traction Company in the beforementioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the keynote to successful battery operation. While in general the reading of the voltmeter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting, owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street, commercial and residential lighting which is now operated by steam.

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At the annual meeting of the Fredericton, N.B., Gas Light Company, a dividend of 4 per cent, on the year's operations was declared, and the old board of directors, composed of Hon. F. P. Thompson, president; Hon. A. F. Randolph, W. T. Whitehead, James Dever and John A. Edwards, were re-elected.

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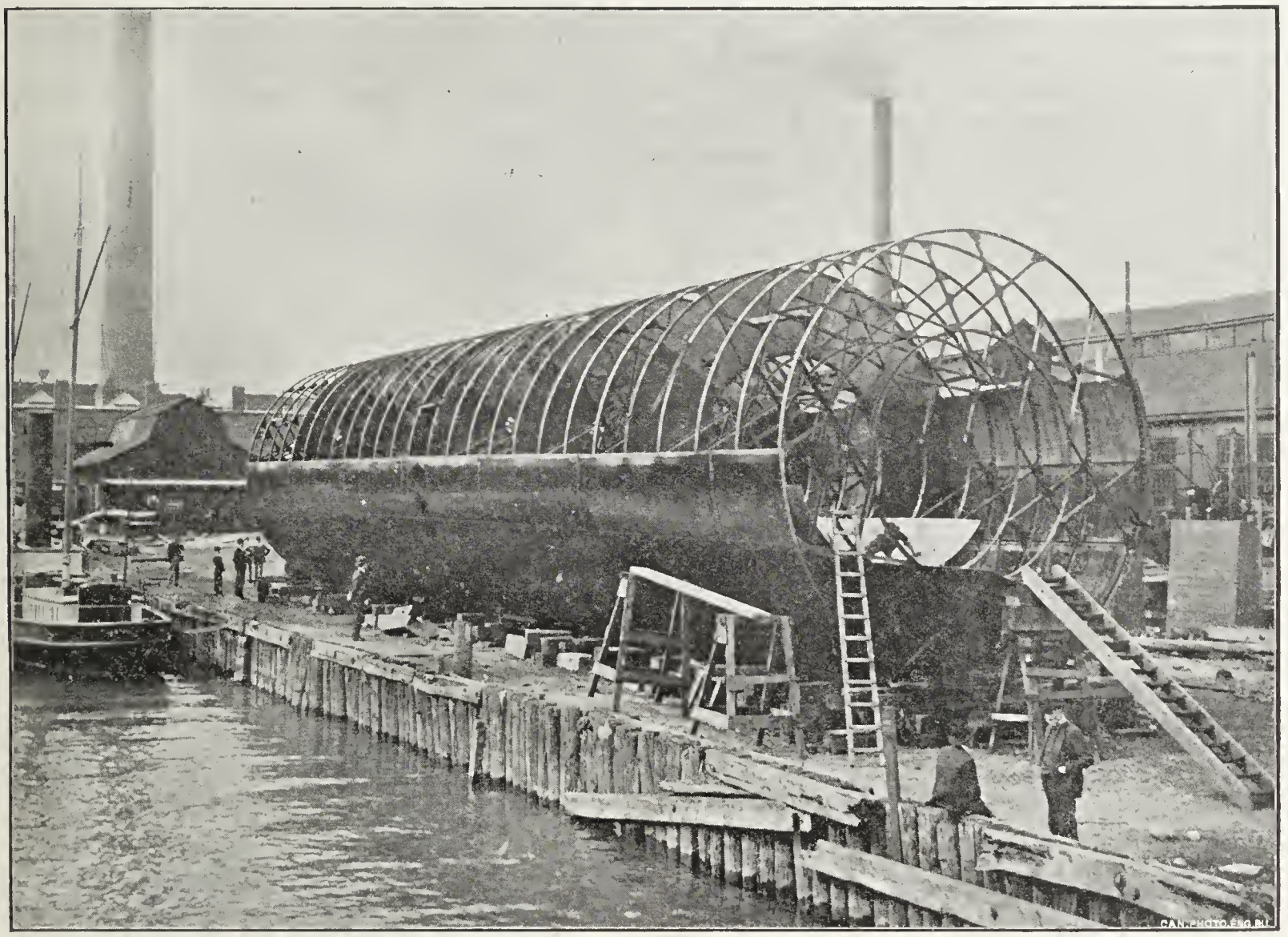
## NOVELTIES IN NAVIGATION.

During the present year, a number of experiments have been made in methods of propelling vessels, some of them novel and some not. Two of these are roller boats, one of which is the invention of a Canadian, F. A. Knapp, a lawyer, of Prescott, Ont. The principle of the roller boat is not by any means new; but there are important differences in the two under consideration from others that have gone before and proved failures. That invented by Bazin, in France, has been tried, and instead of making 30 knots an hour, as it was to do, it only made six or seven. In the first type tried in French waters the engines were not powerful enough; then new engines were put in of three times the power, but the increased weight and force submerged the rollers so that instead of making 40 turns a minute, they only made 10, and they threw up such quantities of water behind that each acted like a brake. Mr. Knapp's boat, which is now being completed at Polson's shipyard in Toronto, is quite different to Bazin's. As shown incomplete in the accompanying engraving, it is a cylinder, looking like a huge steam boiler. It is 110 feet long and 22 feet diameter, the cylinder having an inside diameter of about 12 feet. The engine and platform or cabin for passengers will be placed inside this cylinder, the engine running on a track and turning the cylinder just as a squirrel might turn the cylinder in its cage. The engine being started climbs up its track and turns the drum by its own weight, the drum moving over the water by means of paddles projecting from its outer shell about a foot. The steering gear consists of a steel blade on the lee-board principle, projecting down into the water from each end and lifted or lowered by chains. The smoke will escape by pipes from either end, the inner cylinder being of course open at the ends. Mr. Knapp believes his new boat will make a speed of a mile a minute, and so it may in rolling before a gale, but going against a gale will be quite a different matter. It seems ungracious to have to discourage a thing before its trial, but it is to be feared that Mr. Knapp has not made any mathematical calculations of the enormous force of a gale acting on the broadside of so large a drum elevated so largely out of the water, and he has evidently not considered that though his engines are to be 150 horse-power, their effective power will be limited to a proportion of their weight plus that of the framework, etc., in which they are set. There are other difficulties with regard to stowage of cargo in this outer drum which are likely to crop up on trial. Undoubtedly such a boat should make a good rate of speed in smooth water and with no adverse winds.

Another Canadian inventor, Mr. Charbonneau, is building a boat near Montreal which promises more effective work. The working model of this craft consists of two cylinders somewhat of a torpedo shape, each 8 feet long, 18 inches in diameter placed parallel, and 4 feet apart from centre to centre. Around these cylinders are spiral fins of $1\frac{1}{2}$ turns to the length, one set with a right turn and one with a left. These cylinders are the support of a frame and platform on which a four h.-p. gas engine is being placed, the cylinders being geared to the driving shaft by a bicycle chain. The craft is very steady in the water, and when operated by hand-power only has made a better speed than was expected. Its test with the engine, however, is yet to be made.



Roller Boat.

Herr Vass, a German, is now building a steamer to be propelled by 10 screws, the novel feature of which is that the screws will be placed at the bow and sides, as well as under and at the stern of the vessel. When we state that Herr Vass expects to cross the Atlantic in 16 hours without regard to weather, it will be seen that he is a sanguine man. Although these inventions may prove failures, partially or wholly, they will all have their value as contributing to our stock of knowledge and experience in solving the problems of fast navigation.

## FOUND WANTING.

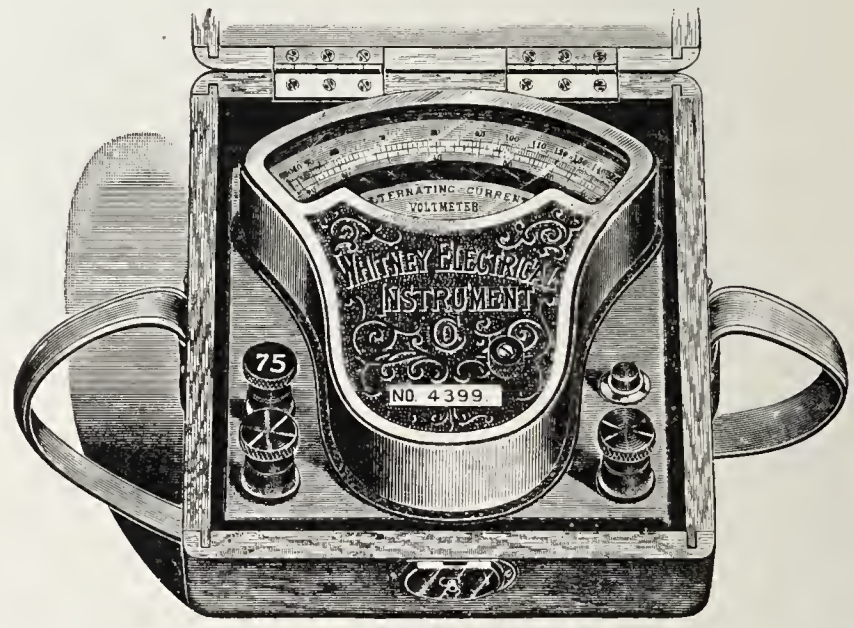
It is of course understood that many of the so-called mines, whose shares are being hawked about, have no existence save in the imagination of the alleged proprietors. That such enterprises should fail is only to be expected, and when it does occur it is a subject of congratulation to everyone interested in the development of our mineral wealth. It is far otherwise, however, when failure comes to a mining enterprise which has been conducted on thoroughly sound business principles, with the most exact scientific information, and the latest and most improved appliances. We refer with regret to the closing down of the Craig mine, Bannockburn, Hastings county, Ont., which took place on the 15th of June, the date of the expiry of the option under which it was held by the Gold Hills Exploration and Development Co. The assays, upon whose showing the working of the mine was determined, gave results indicating the value of about $35 per ton in gold. However, the ore crushed at the Kingston School of Mines, where the test was made, did not represent the average quality of the ore in the mine. The company began work January 1st, and employed about 40 men, day and night, until the 15th of June, when the operations ceased. A Tremaine two-stamp steam stamp, manufactured by the Gates Iron Works, Chicago, the first set up in Canada, was installed, with a 15 horse-power boiler and a Northey pump. Two shafts were sunk, one of 100 feet and one of 35 feet. The vein was also stripped at intervals over the whole property, and samples amounting to several tons taken from each opening. Half way down the main shaft a chute very rich in free gold, but which was very small, was struck. In all about 100 tons of ore were crushed, and the gold recovered is understood to have amounted to between $2 and $3 per ton. Horace Maybee, of the Kingston School of Mines, was in charge of the stamp mills and assaying; Gardner McKenzie, who has had a very long and successful experience in the gold mines of Nova Scotia, was superintendent, and W. Hamilton Merritt visited the mines frequently during the operations, and directed the work of development, so that there can be no question but that the property has had every opportunity to prove itself a valuable mine, and has failed to do so. The Hastings mining boom has received a serious check.

## THE AUTOCAR INDUSTRY UP-TO-DATE.

"Save me from my friends!" the motocycle manufacturer may well exclaim—presuming that those persons claim to be his friends who are so constantly and strenuously puffing the industry and its wonderful development. A few days ago the daily papers announced with a great flourish of trumpets, that on July 16th next ensuing, the Cab Company of Paris, France, would put 500 autocars on the streets, replacing the antiquated animal-power. One of the officials of the company was quoted as saying that within a year 4,000 of such autocars would be running in Paris. A close scrutiny of the matter in quarters not accessible to the general public, reveals that the 4,000 is a myth, the 500 is also a myth, and the plain truth is that the Compagnie des Petites Voitures is "experimenting" with a view to the introduction of autocabs—if a satisfactory system can be found! "The type of vehicle has not been settled upon," but "negotiations" are in progress for the acquirement of a new accumulator "which is expected to give much better results than any now existing." The old, old story! The *Autocar*, the English organ of the movement, states in answer to "A Puzzled Investor," that the total number of autocars delivered from British factories up to date is "probably five-and-twenty, all told!" Some of the factories have been running about a year, others from six to nine months. "There are six companies," the *Autocar* says, "actually delivering commercial vehicles built in this country, viz., Messrs. Stirling, The New Beeston Cycle Co., the Coventry Motor Co., the Thornycroft Steam Wagon Co., and the Daimler Motor Co., and three others which will now commence deliveries in a week or two, these being the Great Horseless Carriage Co., the Arnold Motor Carriage Co., and the Yeovil Motor Carriage Co. Several more are also pushing forward manufacturing preparations." The amount of capital involved in these various enterprises is not stated, but it represents many millions of dollars, and the number of workmen runs into the thousands. Yet the net result to date is 25 autocars! No more striking proof could be given of the absolute accuracy of the article published in the May number of THE CANADIAN ENGINEER, which we suggest might be re-read in view of the facts stated in the above extracts.

## A NEW LINE OF AMMETERS AND VOLTMETERS.

Appreciating the demand for a reliable, but low-priced line of testing voltmeters and ammeters for both direct and alternating current, the Whitney Electrical Instrument Co., of Penacook, N.H., have brought out a modified form of their well known Hoyt type. While it is not by any means their intention to discontinue the manufacture of the latter instruments, it has been found that although by far the most accurate method of taking measurements, instruments operated on the dynamometer principle are not as convenient for rapid testing as are the indicating type, hence the new instruments are in this form, and are constructed with especial reference to making them convenient when used as portable instruments. They are mounted upon handsomely finished mahogany bases and covered with neat dust-proof cases of aluminum, while a strong, well-made, hardwood case with lock and key accompanies each instrument. This case is designed so that the instrument can be used without removing from the case, although it can be readily removed when it is desired to use the instrument for laboratory work. Both the voltmeters and ammeters will read correctly on alternating current of any frequency, as well as on direct current circuits, and there is no appreciable heating error. The




ammeters are made in a variety of ranges from one ampere up to one thousand, and the voltmeters up to ten thousand volts both in single and in double scale. These instruments are tested to stand 2,000 volts between the terminals and cap, thus eliminating all danger in the case of grounds on the line Although the instruments are very compact, occupying a space only 6 x 6 inches, they have a scale length of nearly five inches, thus giving very open deflections.

MR. DOWDALL has been in town for several days taking subscriptions for THE CANADIAN ENGINEER, a monthly journal devoted to the metal trade's interests. We are pleased to know that the subscription list has been largely extended by the names of a goodly number of Orillia citizens, which was to be expected of a progressive community. THE ENGINEER certainly is an up-to-date publication and fills the bill with ability, and is thoroughly wide awake to the interests involved.—*Orillia, Ont., Packet.*

Photo by G. W. Whitaker, Niagara Falls, N.Y.

Canadian Electrical Association.

## CANADIAN ELECTRICAL ASSOCIATION.

SEVENTH ANNUAL CONVENTION.

The seventh annual convention of the Canadian Electrical Association was held at the Dufferin cafe, Niagara Falls, Ont., on the 2nd, 3rd and 4th June, John Yule, president, in the chair.

Among those present were the following : K. J. Dunstan, Frederic Nichols, J. J. Wright, C. H. Mortimer, Geo. A. Wilkie, E. K. M. Wedd, Irving H. Smith, A. A. Christie, A. B. Smith, J. A. Kammerer, W. A. Johnson, A. M. Wickens, W. J. Clarke, E. D. McCormick, W. H. Bourne, Albert Esling, T. F. Dryden, James Milne, F. H. Leonard, jr., J. W. Campbell, Jos. Wright, E. B. Biggar, John C. Gardner, Ross McKenzie, Toronto, Ont.; John Yule, Guelph, Ont.; W. H. Browne, John Carroll, Wm. Thompson, J. A. Baylis, Montreal, Que.; C. B. Hunt, C. E. A. Carr, Capt. Williams, London, Ont.; F. Pepler, Barrie, Ont.; Stephen Noxon, G. E. Gayfer, Ingersoll, Ont.; Henry Comstock, Brockville, Ont.; George Shand, William Williams, Sarnia, Ont.; John Murphy, Ottawa, Ont.; B. F. Reesor, Lindsay, Ont.; H. O. Fisk, Peterborough, Ont.; E. E. Cary, Geo. A. Powell, St. Catharines, Ont.; James Lamont, Chatham, Ont.; Geo. Phemister, Wilfred Phillips, G. E. Foster, Niagara Falls, Ont.; E. T. Freeman, Halifax, N.S.; V. B. Coleman, Port Hope, Ont.; John Farley, St. Thomas, Ont.; F. A. Bowman, New Glasgow, N.S.; J. W. Purcell, Walkerville, Ont.; W. H. Bullard, Seaforth, Ont.; C. H. Philbrook, H. E. Adams, Buffalo, N.Y.; W. J. Johnston, Wm. McCullough, New York, N.Y.; Geo. Black, W. F. McLean, F. W. Martin, Gordon J. Henderson, B. J. Throop, Thomas Wadland, Q. C. Baker, Hamilton, Ont.; Thomas Duncan, Fort Wayne, Ind.; C. J. Page, Welland, Ont.; J. M. Brown, Carleton Place, Ont.; Chas. E. Taylor, Sault Ste. Marie, Ont.

The president, having welcomed the members, delivered his annual address, in which he spoke of the appropriateness of having the convention at a place like Niagara Falls, which afforded so many object lessons in electrical enterprises. In the course of his address he spoke of the question of municipal control of electric plants, as a subject of the deepest moment. The movement was gathering strength in spite of repulses, and some means would have to be devised to prevent a large part of the capital invested in the electric lighting business from being wiped out. "We hear," said he, "of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city ; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity. They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was at one time, by the same people, lauded as creditable enterprise on the part of their fellow-citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air, and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe, in dealing with the telephone question, admits this principle in pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on 'Monopolies and the People,' where the author tersely sets forth the evils of the popular attitude towards competition projects :—'Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval, and, under the impression that they are benefiting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known.' In Great Britain the Government forbids by legislative enactments, local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1,318 gas undertakings operated by companies, and only 165 managed by municipalities. This, in view of the fact that said muncipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 30 years." The president then went on to speak of the Electric Lighting Act of Great Britain, which provides for the method in which lighting companies are to be started. Companies can be organized, and on proving their good faith and ability to carry on business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the Government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation, and gives a monopoly of the business under proper control.. Municipalities are not required to pay any price demanded by the company for lighting service. The company is compelled on a requisition from the local authorities to erect and supply street lights ; the distances apart and other necessary conditions are prescribed in the General Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade

appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. In the State of Massachusetts all gas and electric light companies are supervised by a board of control, which has now existed for 13 years. When complaints are made, or applications for reduction in price etc., the board hears evidence and gives judgment, which is usually based on common sense and equity. Every lighting company in the State is required annually to make a return, giving full particulars as to capital, income, expenses, dividends paid, etc. In 1896 there were returns from 63 companies; 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy and populous manufacturing State like Massachusetts, he thought statistics would show Canadian companies to be worse off." He advocated an Ontario law, based partly on the British and partly on the Massachusetts laws. In closing his address the president made a feeling reference to the untimely death of their respected late second vice-president, E. Carl Breithaupt, and said, "I am sure I express the opinion of all who had the pleasure of knowing him, that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our association."

On motion of C. B. Hunt, seconded by J. J. Wright, the following were named a committee to consider and report on the recommendations contained in the president's address: Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock, and the mover.

The secretary-treasurer, C. H. Mortimer, then read his annual report, which showed that there had been added during the year 42 active members and two associate members, while nine active members and five associate members had resigned, and 33 active members and 14 associates had been struck off the roll for non-payment of fees. Two members, E. Carl Breithaupt and A. W. Congdon, were removed by death—a loss deeply deplored. The membership roll now comprises 154 active members and 19 associate members, a total of 173. The finances were reported in a good condition. The total receipts were $940.36, an increase of $448.03 over the previous year, while the disbursements were $352.47, an increase of $165.86 over the previous year, leaving a net gain of $282.17. The cash in hand and in bank on 31st May, 1897, was $415.82. The report was adopted.

J. J. Wright, on behalf of the Committee on Legislation, reported that during the past year there was no legislation that affected the interests of the members generally. He also reported that nothing had been done by the committee to interview the Government on the question of meters. They found that the officials of the Government were disposed to meet them in every reasonable way, and there was no urgent necessity under the circumstances to have an interview with the Government. The coming year, however, bids fair to be an important one for these committees.

The report of the Committee on Statistics was not presented, owing to the death of the chairman, E. Carl Breithaupt, who at the time of his death had a considerable amount of unassimilated material in the way of reports, which have not yet been obtained from his executors.

The president named B. F. Reesor, C. B. Hunt and A. B. Smith as a committee to nominate the standing committees.

Mr. Hunt called attention to the Government's new order-in-Council regarding the inspection of meters. By this order the charge for inspection is per lamp instead of per ampere. To those having a 106-volt or a 110-volt service the rate is very much increased. Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now $1.25; on a 15 ampere meter it is increased from $1.25 to $1.75; on a 25 ampere meter it is increased from $1.75 to $2.25; on a 50 ampere meter it is increased from $2.75 to $3.50; on a 100 ampere meter it is increased from $3.50 to $5.50, and on a 150 ampere meter it is increased from $4.25 to $7.50. If you happen to have three wire meters it will be pretty nearly double that again. It was decided to bring the matter up the next day.

A paper on "Water-Driven Plants," an abstract of which will be found elsewhere, was then read by John Murphy, of Montreal.

The President said the most satisfactory regulation he found was a quick-acting engine on the same shaft with the water wheel.

H. O. Fisk—Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

B. F. Reesor—I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine—but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. The same thing holds good with an engine or water wheel, but much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare.

Mr. Fisk—In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at Niagara Falls power-house now that keeps a constant load on the generator all the time.

S. Noxon said he had experience of water power at Walkerton, in driving two or three mills. He came to the conclusion that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor. The trouble was to get the wheel to respond quickly. It can be done under a high head, because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds.

A. M. Wickens, Toronto, was then called on to read his paper, entitled the "Steam End of an Electric Plant," which, with the discussion on it, will appear in next issue.

When the discussion on this paper closed the convention adjourned for a trip to Buffalo in the evening, where an inspection was made of the electrical developments there.

On assembling for the second day, the president read telegrams from O. Higman, of Ottawa, then at Vancouver, and from L. B. Macfarlane, Montreal, regretting their absence from the meeting.

On behalf of the committee to nominate the Standing Committees, Mr. Reesor reported the following nominations, which were accepted:—

Committee on Statistics—A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection—J. J. Wright, C. Berkeley Powell, and James Milne.

Committee on Legislation—John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker and F. Pepler.

W. H. Comstock, chairman of the committee to consider the recommendations in the president's address, reported in favor of action by the Committee on Legislation, who should be empowered to raise money for the purpose. On motion of Mr. Armstrong, seconded by Mr. Reesor, the report was adopted.

J. A. Kammerer then read his paper on "Day Loads for Central Stations and How to Increase Them." The paper appears elsewhere.

Mr. Wright said he remembered, when a boy, seeing a conjuror who poured three different kinds of wine out of one bottle. He thought it very wonderful at that time, but since then he learned that it was a fake bottle—it wasn't exactly genuine. Now he did not mean to say that a dynamo that would produce arc lighting, incandescent lighting, and power was a fake dynamo, but if the three kinds of current can be produced as easily and successfully as the gentleman he referred to

seemed to pour out his wine, we as central station men ought to know about it.

W. H. Browne, of the Royal Electric Co., Montreal, said: I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 horse-power, a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjuration of this fake bottle has disappeared.

Mr. Wright said he was aware that it could be done; the question was whether it was practically a success. In Toronto they had services on separate wires, and they would like to get them on the same machines, if they could get steady incandescent lighting while constant draughts were being made on the same dynamos for motor power.

Mr. Fisk said the few motors they were running in Peterboro' did not seem to make any difference with their lighting.

Mr. Milne thought it impossible to have perfect regulation where one had a lot of motors requiring heavy powers. Take, said he, the Edison three-wire system, where an electric elevator is turned on, taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve horse-power motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three-wire system for several years, with a day load probably of about 1,500 of 1,600 amperes power load, yet it cannot be said to be extremely satisfactory.

Mr. Browne replied that Mr. Milne had not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights, and went on to say: I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in Toronto, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it; if your direct current machine does not regulate for it your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point that has not been touched upon, and which seems to me really more material to the smaller central stations who are at present operating a day load. The main difficulty experienced in working up a power business in connection with the smaller stations is that of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor, in the smaller sizes, up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, becauses I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not aware of any alternating system in which that difficulty is entirely removed.

In reply to Mr. Pepler, Mr. Armstrong said the same difficulty would occur in the case of a railway operated during the day.

Mr. Browne observed that the real difficulty in these cases was that the prime mover, whether a water wheel or an engine, was not large enough for the work.

Mr. Armstrong: It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, so that even if the whole load is thrown off instantaneously, it will not effect the service. There is this difference in a railway service, that it has a variation of 10, 15, and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, due to the change of speed primarily, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service.

Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the difficulty in small plants occasioned by putting a motor on or off is due to the disproportion between the size, say of a 20 or 30 h.p. motor and a 75 or 100 h.p. generator, still I do not think he would propose as a remedy that you should all put in 300 or 400 h.p.

Mr. Reesor said that in a small town a company could not afford to throw away their transformers and get nothing for them, but in a big city the loss would be equalized.

Mr. Kammerer pointed out that his paper distinctly referred to transformer losses, and said that this was being regulated by the reconstruction or rearrangement of the separate stations.

Mr. Farley said it would seem that we had not arrived at that stage where electricians could all agree that all these serivces could be provided for over the same lines by the same dynamo, but for a small company it was very important that it should be done.

Mr. Armstrong : I think there is no person who will question the perfect feasibility and desirability of operating a lighting station (especially a small one),. and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances.

In answer to a question, Mr. Browne said that in calculating the cost of such a plant, we have two fixed items—the interest upon the capital invested and the labor necessary to produce; so it may be ascertained by any one how much it will cost him to serve light or power. The additional cost will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for; that is why power service or day service will pay the station, because you are getting something in return for capital invested and for the labor that you necessarily employ. Leakage from the old style of transformers would be disastrous in this method, but transformers can now be supplied to reduce the leakage from 150 h.p. to 10 h.p. on a 7,000-light plant.

After some discussion on the next place of meeting, it was unanimously decided to hold the convention of 1898 at Montreal.

Wm. Thompson, Montreal, then read his paper on the "Determination of the Heating Power and Steam-Producing Value of Coals from a Preliminary Examination," which, with the discussion on it, will be found in our next number.

At the noon recess, on the invitation of Wilfred Phillips, the manager of the Niagara Falls Park and River railway, the members visited the company's fine power-house, near the Falls.

On resuming, the first business brought up was the election of officers.

J. Carroll stated that L. B. Macfarlane had requested that his name should not be brought up for re-election to office for the coming year, as it would be impossible for him to serve the association as he would like.

After some discussion the following officers were elected :

President, John Yule, Guleph (re-elected by acclamation); 1st vice-president, C. B. Hunt, London (acclamation); 2nd vice-president, J. A. Kammerer, Toronto (acclamation); secretary-treasurer, C. H. Mortimer, Toronto (acclamation). Executive Council—F. C. Armstrong, Toronto; J. J. Wright, Toronto; John Carroll, Montreal; A. B. Smith, Toronto; O. Higman, Ottawa; F. A. Bowman, New Glasgow, N.S.; W. H. Browne, Montreal ; Wm. Thompson, Montreal ; Wilfred Phillips, Niagara Falls; and A. A. Dion, Ottawa.

The usual bonus of $75 was voted to Mr. Mortimer for his services as secretary.

F. C. Armstrong then read his paper on "Why Some Lighting Plants do not Pay," the text of which will be found in another part of this issue. Mr. Armstrong explained that owing to the press of other work, he could not cover the whole field he had mapped out, and was obliged to cut it in two.

Mr. Browne complimented Mr. Armstrong on his paper, which was well thought out and well constructed ; but for the purpose of starting a discussion he would take issue with Mr. Armstrong on the question of rates. He found with flat rates that the maximum output is taxed to its utmost, with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. The idea is this : your customer has a certain number of lamps on his premises; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. Armstrong : The method Mr. Browne speaks of is, I believe, quite general in England; it is practically giving a discount to the consumer, proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view, but my idea in pointing this out was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis.

S. Noxon was glad to see Mr. Armstrong had cracked a nut and exposed the kernel on a question of great importance to central station managers. His own company was supplying electricity upon the flat rate basis, and although they had pondered over this matter the objections which seemed to present themselves to us were such that we could not see our way to changing our system. And in this he differed from Mr. Browne in his experience. It was easier to get a customer to pay a uniform rate per month on a flat rate than to get him to pay a large rate per month during the heavy lighting season, and a smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays.

W. Thompson : I have at present both meter rates and flat rates, and I must say that the flat rates are an abomination to me. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb, are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 or 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the flat rates at 30 cents a month wouldn't pay the interest on the capital alone.

Mr. Armstrong pointed out that Mr. Thompson was near Montreal, where city conditions existed. If one could get paid for everything that passed through the meter it would be satisfactory, but measuring the ampere hours does not represent the value of what is passing through your meter.

Mr. Pepler : I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no way of checking the consumption. There is no question, it is easier to deal with customers on the flat rate than on the meter

plan. We are now on the meter system, but it is not altogether satisfactory, and not popular. When you are in the hands of a municipality you have got to consider that question. We are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take—and partly by way of increasing the number of our small consumers); we are proposing to have a sort of combined plant; to continue the meter plant for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of $75, and a still larger discount to consumers over $100.

Mr. Browne thought the difficulty of dealing with customers greatly exaggerated. When the question of complaints from customers came up, he said to his clerks : We will insist upon our station men operating the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; and when we have done that we will say to our customers : If you find any fault with your bill consult your meter. I adopted the plan of making a test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded ; the man never complained the second time ; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light, are able to use the meter to check the consumption by employees. In one case the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the lighting. The great trouble we find in the business is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. Charging by the flat rate is not honest; it is not fair to the consumer in the summer time, who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay $10 when he has only used $3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is $75 or $100 a month; that is a matter of no consequence ; the man that pays you $75 may not be as good a customer as the man who pays you $5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. Reesor : I am thoroughly in sympathy with using meters ; we are working into the meter system. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way : We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in the morning when they start up they have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a larger quantity he gets a larger discount, and we make the rate low. We do the same thing with other customers.

F. A. Bowman : I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible, to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can over-wire very much more largely when you have a number of meters in than you can under any other conditions. When we make flat rates we base them on what we consider would be a fair average consumption through the year. I know you have to keep constant watch or else you will find them leaving the lights on ; you will find some customers leaving lights on every night and all night. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps, whereas on the meter basis we can figure on 5 c.p. and 10 c.p. I might say in this connection that I have rather a unique scheme; I have a small town where I am lighting the streets on the meter system ; in other words, we put in an independent circuit, on a three-wire circuit, centred at the Town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system.

H. O. Fisk : In regard to the flat rate system, we ran against a snag that I have not heard mentioned ; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c.p. lamps. This thing went on for a year or so, the load got tremendously heavy, and the income didn't come up, so we sent an unknown man to investigate. He went around and looked at all the lights, and the result was that about ninety-eight per cent. of our 10 c.p. lamps were 16 c.p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps. With reference to the meter rate, we made a discount about a year ago of 33 1-3 per cent. of what we were charging, for all bills paid before the 10th of the month. The result was that by the 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one, would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33 1-3 per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way.

In the course of further discussion, Mr. Browne said : In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at midwinter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent.: in other words, you will have 1,000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine.

Mr. Noxon : We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine ?

Mr. Browne : If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 5,000 lights on a thousand light capacity. In Montreal to-day we have wired up on our circuits 65,000 lights ; we are serving those lights with five 300 kilowatt machines, that is, 1,500 kilowatt capacity, and we always have one to spare.

Mr. Armstrong : Those who are in favor of the meter system hold that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, that for plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time as very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make

the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of eharging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator.

J. M. Browne : I run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too light. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near future my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. For commercial lighting you should havc an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should bc run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a faet that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them.

C. E. A. Carr, of London, then read his paper on " Electric Railways; How to Make Them a Commercial Sueeess."

Mr. Browne : Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested.

The President then called upon W. A. Johnson, of Toronto, to read his paper on " Accumulators—Their Application to Central Station Lighting and Power." Mr. Johnson's paper is printed in this issue.

J. Farley said that while all the papers had been exceedingly interesting, there was none probably that has a more practical bearing on the future than Mr. Johnson's.

Mr. Browne asked as to the cost of maintenance of the storage battcry.

Mr. Johnson : During the three years in which time the modern type of battery has been in use in central stations on this eontinent, there is good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purehasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne : If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. Armstrong : The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty ?

Mr. Browne : By operating a direet current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an effieiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson : There are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the eity and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled as easily, perhaps, with the same generators as through the usual alternating circuits ; that would apply especially to a water power that was not large.

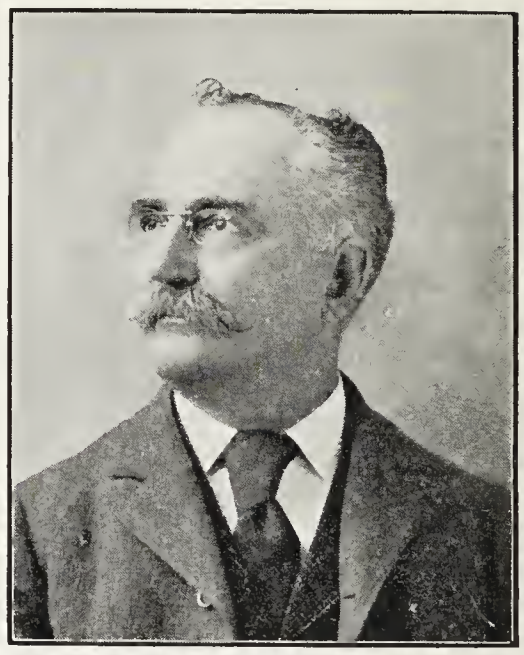
The paper by D. H. Keeley, on " Economy in Cireuits," was taken as read, and is crowded out of this issue.

Votes of thanks were passed to the authors of the various papers, to Mr. Phillips, of the Niagara Falls Power and River railway, for the efforts he made for the success of the convention; to the various companies that had contributed to the entertainment of the convention, and to the press.

The annual dinner took place on Thursday evening, June 3rd, and Friday was devoted to sight-seeing. Reference to these features will be found under another heading.

JOHN YULE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

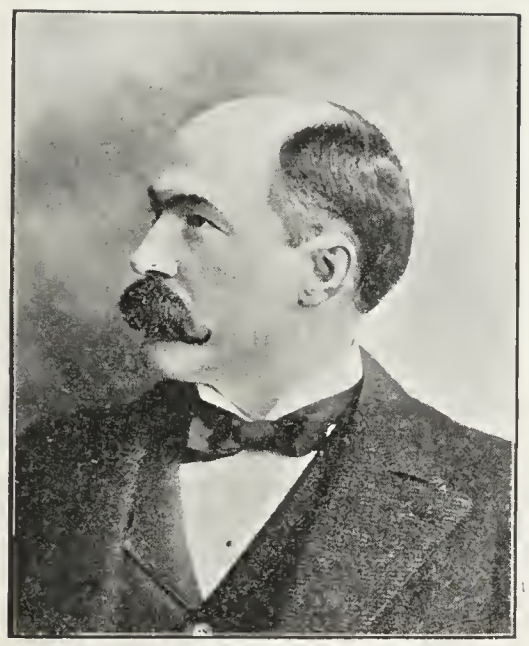
A biographical sketch of Mr. Yule appeared in THE CANADIAN ENGINEER last year.



CHAS. BREWER HUNT, FIRST VICE-PRESIDENT.

CHAS. BREWER HUNT, manager London Electric Company, 1st vice-president of the Canadian Electrical Association, 1897, was born at Windsor, Ont., November, 1849. His first venture in the electric business was in 1878, when he built a private telephone line in London, with two calls upon it, extending from his office, corner of Richmond and King streets, to Hunt City Mills This was the first telephone line doing practical work in London, and was the beginning of a telephone exchange, which was established by Mr. Hunt and several other gentlemen a few months later, and which was sold out at a good profit to the present Bell Telephone Company a year or so afterwards. Shortly after this, Mr. Hunt became interested in a small arc lighting plant, which was started in London by the Royal Electric Company. This being the first electric plant established in that neighborhood, was an object of great interest to all who chanced to see it. Mr. Hunt himself being infatuated with the mysterious working of the electric arc dynamos, decided, in company with his brother, to buy out the Royal Electric Company's interest. This was the starting of the present large and flourishing business carried on by the London Electric Company, of which the subject of this notice is now the manager. Mr. Hunt retains the fullest confidence of all the directors, many of whom

are residents of Toronto. He is also largely interested in the London Street Railway, which was recently converted from a horse to an electric road, and is, undoubtedly, one of the finest equipped electric railways in Ontario. Mr. Hunt takes an active interest in all matters connected with the Canadian Electrical Association, and any member visiting London will, we feel sure, be welcomed by him at the London Electric Company Power House.



J. A. KAMMERER, SECOND VICE-PRESIDENT.

J. A. Kammerer was born at Niagara Falls, N.Y., about 40 years ago. From 1871 until 1891 he was connected with the telegraph and telephone service throughout the United States. He took up electric lighting in 1888. He came to Canada in 1891 and entered the service of the Royal Electric Co., Montreal, in April of that year, as sales agent, and spent a year in Manitoba and the North-West Territories He then came to Toronto, in the interest of the company, and took charge of the Ontario district for about a year, when he was appointed general agent for the company.

## COMMENTS ON THE CONVENTION, AND NOTES ON NIAGARA.

The seventh convention of the Canadian Electrical Association was, all things considered, the best yet held, a feature specially notable about it being the large attendance of central station men, and the interest they took in the proceedings.

The re-election of Mr. Yule, though not anticipated in the ordinary course of official changes, is a popular appointment, as he has worked hard and intelligently, and has neglected nothing that he has conceived to be in the interests of the association. Messrs. Hunt and Kammerer, as vice-presidents, will both make excellent officers, for both have good business abilities, as well as a knowledge of the needs of the association.

The members were loud in their praises of the services of Wilfred Phillips, the genial manager of the Niagara Falls Park and River Railway, to whose kindness and forethought the association were so much indebted for the pleasures which have made this convention one to be remembered. Mr. Phillips' services to the association, though so important, were rendered with the modesty that is so natural to him, and the vote of thanks to him, passed at the convention, was no mere formality. Certainly the trip over the Niagara Falls Park and River Railway was one that will not be forgotten by the visitors.

There is not a foot of the route traversed by the Niagara Falls Park and River Railway from Queenston to Chippewa that does not present some scene that has a charm to the traveller. The wonders and beauties of Niagara are not to be realized in a day, and the scenery along this favorite route cannot be fully appreciated in one trip. Indeed one of the oldest residents at the Falls observed to the writer that he never goes up and down this wonderful river without making some new scenic discovery that charms and surprises him. In this respect the Canadian side of the river is remarkable; and while about two-thirds of the water of the whole river pours down on the Canadian side, it is also true that two-thirds of the great natural features about the Falls are to be found on Canadian territory. While this is true, it must be admitted that because of superior energy, combined with other causes, the Americans have made far greater commercial use of their opportunities than we have. The engravings we give in connection with these sketches illustrate this remark. We have all the grand natural scenery, they have the big hotels and the business that flows from them; we have most of the water power, they monopolize nearly all that has been developed. The Niagara Falls Park and River Railway are the only users of power from the Niagara on the Canadian side, and they, unfortunately, are not permitted under their charter to sell power or use it for other than their own railway requirements. Readers of THE CANADIAN ENGINEER are aware that the vast water-power on the Canadian side has been tied up by an unfortunate bargain with the company known as the Canadian Niagara Falls Power Co, composed in reality of members of the Cataract Construction Co. who own the big electric power works on the American side. It will be remembered that this company recently applied for an extension of time in which to complete their power works on the Canadian side, and if this time had been granted it would have tied up the Canadian power development for another period, and fastened a most undesirable monopoly on the Province of Ontario—for it is a question whether any independent company would have the right to take water from around the Canadian Falls if the conditions made with the so-called Canadian company had been fulfilled. Indeed, as matters stand, the claims of another company who propose to draw water from the Welland (Chippewa) River by a canal and discharge it under the Park grounds just below the falls, have not yet been determined. Quite recently this question was brought before the Ontario Court of Appeal for an opinion as to the status of the parties, but the promoters of the Welland River scheme, known locally as the "Canal scheme," withdrew the reference to the court, apparently preferring to start in and take their chances of a favorable interpretation afterwards. Having already made preliminary surveys, they last month started a few men on digging a ditch above the falls, and a representative of this paper was informed that an announcement of their plans would be made in a short time. This scheme is not to be confounded with that of the Cataract Power Co. promoted by John Patterson, of Hamilton, who proposed to convey water to a point near De Cew's Falls and carry electric power thence to Hamilton. Meantime the American syndicate, who counted easily on the Ontario Government granting the delay asked for, but who have been informed that the works must be completed as first agreed by November 1st, 1898, have been digesting plans by which they can save their charter and the $25,000 rent they have been paying to the Queen Victoria N.F. Park Commission since 1892. Engineers have staked out the site, borings have been made through rock that is to be pierced by the big shafts, and it is said that the new machinery for carrying out the work will be on the ground from the United States next month. So, between the two or three schemes pending, we may at last look for the building of the great industrial enterprises that should have been commenced long ago on the Canadian side of the world's greatest water power.

Meantime the only existing power we can boast of is that owned by the N. F. P. & R. Railway, views of whose power house are given herewith. It has a capacity for 3,000 h.p., of which 2,000 h p. have been put in. The present power is provided by two wheels of 1,000 h.p each, built by Wm. Kennedy & Sons, of Owen Sound. There are three Canadian electric generators of 200 K.W. each, the company still using also its steam power generators at Queenston to surmount the steep hill there. The electrical installation was made under the superintendence of Mr. Phillips, who was then the electrician of the road, and everything works with admirable smoothness. The construction of the road, which is 13½ miles long, reflects great credit on W. T. Jennings, C.E., Toronto, who supervised the work. It is well ballasted, with heavy ties and heavy steel rails, and guard rails are placed wherever the track curves near the river bank. The cars are exceptionally strong, with solid steel 33-inch wheels, and heavy steel axles. Some cars are built with three tiers of seats running longitudinally, so that all passengers can view the scenes below without rising from their seats.

The business of the Canadian convention closed by a banquet at the Dufferin Cafe. The dinner was excellent and was well served, and the arrangement of the whole programme reflected much credit on the committee, which was composed of E. E. Cary, chairman; F. C. Armstrong, C. B. Hunt, W. Phillips and A. B. Smith. After the Queen had been loyally toasted, "Our Guests" was proposed and replied to by James Wilson, of the Niagara Falls Park Commission; Mr. Lincoln, of the Cataract Construction Co., and James Innes, ex-M.P. of Guelph. Mr. Wilson referred to the attractions of Niagara and pointed to the great electrical works on the American side as a foretaste of what might soon be expected on the Canadian side. Mr. Innes in his speech paid a compliment to the ability and energy of the chairman (Mr. Yule). He remembered, as a press man, coming down to see the first coal oil lamp, which seemed a remarkable advance in the progress of house illumination, but no one seemed to conceive then of the wonders of electric lighting. "The Electrical Industries" was replied to by W. H. Browne, of Montreal, who looked forward to the time when this association would no longer be limited to questions of electric light, but when heat, power and chemical work would come in for an equal share of

attention—for there was a tendency to transform electricity into all forms of power. He was associated with what was probably the first electric railway in the world—in Virginia in 1887—when there seemed but little probability of the present attainments in electric railway operations; but now that the experiments of the N. Y. and New England railway with the third-rail system had proved so successful, it was quite possible that within another five years the steam locomotive would be practically superseded by the electric one. Even now the G.T.R. contemplate the operation of all their lines around Montreal by electricity. The ease of transportation is bringing the country into the city and giving the city access to the country, and the next step is the carrying on of farm work by electricity, and then we shall have the horseless era. The time was not far off when cooking and the commoner forms of labor will be done by electricity, so that lighting will be the least important branch of the electrical field. There was a great opportunity for the young to study this great power field. H. P. Dwight, of the G.N.W. Telegraph Company, also replied, giving interesting reminiscences of the early days of the telegraph. After letters of regret were read from absent friends, the toast of the "Ladies" was responded to by F. C. Armstrong, in a humorous speech, and the "Press," the last toast, was replied to by W. J. Johnston, of the *Electrical World*, New York. Mr. Johnston told how his paper was first started 23 years ago under the name of the *Operator*, and came into existence to represent the interests of telegraph operators. The paper followed the advances and changes of electrical work, until now few would trace the relationship of the present volumes to those of its humble beginning.

The miniature incandescent lamp formed into a scarf pin, distributed by the Canadian General Electric Company, was the best appreciated souvenir of the convention, and the demand was much greater than the supply. At the National Electric Light Association's gathering on the New York side there were souvenirs in abundance, from lead pencils and paper weights to sections of cable and chunks of carborundum; but wherever THE CANADIAN ENGINEER man went with his miniature lamp displayed on his badge he was asked, "Who's giving out that lamp?"

Speaking of carborundum and the American convention, the special industries gathered round the water power district of the American Falls are an interesting sight, and an object lesson to Canadians, who are allowing time and opportunity to slip by in the development of like Canadian industries. Some of these American factories are kept strictly closed to visitors who have not some special "pull" with the owners, but others are freely open. There are the big aluminum works of the Pittsburg Reduction Co., the Carborundum Works, the Calcium Carbide Works, the works where the electrical production of soda and other chemicals is carried on, the Mathieson Alkali Works, and there are paper mills, pulp mills, lumber mills, foundries, all of which have combined to double the population since 1890. The latest of the large special industries to be established here is the American branch of the Oldbury Chemical Company, near Birmingham, England, who are large manufacturers of electro-chemical products and who have two and a half acres of ground for their new plant now being erected. In this connection it must not be supposed that the Cataract Construction Company are the only developers of power here, for the company known as the Niagara Falls Hydraulic Power and Manufacturing Co., supply eight concerns with water-power, ten concerns with electric power, and two with mechanical power furnished from their shafts. This company was in existence years before the Cataract Construction Co., and have a canal of their own through which water is led from above the falls sufficient to generate 150,000 horse-power, of which about 40,000 horse-power is now developed and used. A view of the river bank displaying some of the cataracts from their discharge pipes and tunnels is shown in this issue. The hydraulic engineer of this company is W. C. Johnson, of Niagara Falls, N.Y., who has made a special study of hydraulics and who has solved many difficult problems in the erection of various works here. Through the courtesy of Mr. Johnson, our representative was shown through the various factories where these problems have been worked out.

On Friday morning, before the members started out on their sight-seeing jaunt, they were greeted with a summary report of the convention, which Mr. Mortimer, with commendable enterprise, had compiled, one page being devoted to humorous skits, which were taken in good part by those who were "skitted."

To the Toronto members one of the pleasantest features of the convention was the trip across the lake and back by the Niagara Navigation Co.'s fine steamers. It seems like getting into a new country to face the cool and appetizing breezes of that grand old lake, and everybody enjoyed the trip as if it had been their first.

Then there is the Niagara Falls Power Company, associated with the Cataract Construction Company, having a tunnel of 100,000 h.p. capacity, and a second tunnel which will yield 150,000 h.p. So that the American power works, when developed, can supply 400,000 h.p. It may here be noted that the three tunnels contemplated by the Canadian Niagara Falls Power Company would yield a total of 350,000 h p. The N. F. Power Company have so far laid out about $7,000,000 in plant and property on the American side, but have bought no land on the Canadian side, except for the immediate works of the Can. N. F. Power Co The N. F. Power Company now supply hydraulic power to one company to the extent of 7,200 h.p., and electric power to 21 companies to the extent of 14,695 h.p., besides the 5,000 electrical h.p. they send to Buffalo, making a total of 26,895 h.p. which they now furnish. Besides their large interests in Niagara Falls city, they own the suburban village of Echota, which they are building up, and the houses in which are all rented at a reasonable price, which always includes water supply and electric light. The power furnished from their three big dynamos of 5,000 h.p. each (described in a former number) has of course all been taken up, and the company are pushing ahead with excavations for seven or eight new wheel pits, so that it will probably not be long before the whole 50,000 h.p., for which this power house is planned, will be taken up.

Among the most interesting of the special industries of this place is the works of the Carborundum Co. What is carborundum? It is made by four s's—sand, sugar, salt and sawdust. These simple materials are mixed and fused in an electric furnace at a low heat, and the result is carbide of silicon, or carborundum, which is a mass of crystals as hard as diamonds. They are in effect artificial diamonds, and their commercial use is as an abrasive. The crystals after being reduced to all grades of fineness are mixed with porcelain or other material, and made into cylinders, discs, straps, boards and blocks for use in grinding and polishing, from delicate dental and jewlery work to the coarsest machine and tool work. For these purposes it is fast superseding emery and corundum, for though dearer to begin with, it is vastly superior in life and efficiency. The company started recently with capacity to produce 300 lbs. per day, but so great has been the demand that they are now turning out 10,000 lbs. per day; and the 1,000 horse-power which they are now using requires to be doubled to 2,000 h.p. More than this, the company are now preparing to equip a branch plant in Canada, of which THE CANADIAN ENGINEER will give particulars later on. Reserving a detailed description of its manufacture till then, we may observe that carborundum is both infusible and insoluble—neither oils, water nor acids affect it. Even hydrofluoric acid, which dissolves all the silicates—does not eat it. The colors of the crystals as they come from the furnace vary from pale greens to cobalt blues and violets, and their sheen is beautiful beyond description.

The Pittsburg Reduction Co. started the manufacture of aluminum at Niagara Falls in 1895 with 1,500 h.p; now they have two establishments here, using over 6,000 h.p. The direct electric current is essential to the making of aluminum, so that this is likely to be the headquarters of this industry. Indeed, it is understood that this company, while controlling the entire output of the United States, are now securing control of the European market, and would so rule the world's product of this metal, as the Standard Oil Co. does that of petroleum and its products. While the output of aluminum is steadily increasing, the reader should be informed that a great many of the uses for which it has been so highly lauded have been proved to be impracticable. Some enthusiasts imagined that aluminum was to supersede every other metal under the sun, and when its failure was demonstrated to the cost of experimenters in many lines, it has got a "black eye" in other quarters where it did not deserve it. The fact is that aluminum has a low melting point, and for uses where the metal is subjected to intense or prolonged heat, it is a failure. It is successfully used to make many articles of household use, such as cooking utensils and articles in which lightness is an object, and a factory exists near the Reduction Company's works that is turning out large quantities of such articles. Among the items which the Reduction Company put in their price-list are ingot, in pure aluminum and in alloys, but it is noted that the metal is not suited for alloying with brass or zinc, though a special casting is made as a substitute for brass. These ingots range from 31 to 42 cents per lb., and aluminum castings at 45 cents per lb. upwards, according to circumstances. Rolled rods, wire plates and sheets are made at corresponding prices. Under certain conditions aluminum wire is being successfully used instead of copper wire for the transmission of electricity.

After an interesting trip over the "Gorge Route" electric railway, on the American side, the Canadian convention came to a delightful close by a run into the foot of the cataract on the steamer "Maid of the Mist," by courtesy of the genial Capt. Carter, whose own trusty hand was at the helm.

The American convention (National Electric Light Association), from June 8th to 10th, was characterized by the usual vim and bustle of our cousins across the border. The International Hotel was a humming throng each day, and numerous exhibits, which could not be placed in one room, were scattered among the private apartments of the hotel. It is to be hoped that the day will come when the Canadian electrical interests will also be able to make a good exhibition as a feature of the convention. To us the American convention had a special interest, derived from the fact that a Canadian, who had sat on the council for five years, during which he had been elected successively to the second and first vice-presidencies, was now in the sixth year sitting as president over the most influential electrical institution in the Union. And a very able and diplomatic president he made, as was generously conceded by the technical press. The selection of him was an honor to Canada, and not to Mr. Nicholls only.

In his presidential term, Mr. Nicholls introduced the idea of interim presidential messages, which may well be adopted by presidents of other bodies. Whenever any question of importance cropped up he did not wait till the annual meeting, but sent out a message to the association giving information, or soliciting or giving opinions on the subject. Where members of an association are scattered over a wide geographical area, and special meetings are inconvenient and expensive, the plan is a good one.

The photo from which the engraving at the head of our convention report is made, was taken by G. W. Whitaker, the skillful photographer at the Hotel Lafayette, which was the headquarters of the Canadian convention.

One of the instructive sights to the visitor interested in engineering is the new steel arch bridge over the Niagara, replacing the old suspension bridge at Clifton, about which we hope to give something in next issue. The new bridge is built below and around the suspension bridge, so that when the cables of the old were removed it rested on the new structure, which will be finished without interrupting the railway traffic a single hour. The work will perhaps be finished by the time these pages are in the hands of the reader. The wires which form the big cables of the old bridge were perfectly sound, and it is understood they have been bought up by a Montreal firm to be manufactured into wire nails.

Speaking of bridges, it is understood that the new upper suspension bridge near the falls will be at once replaced by a new steel arch bridge, if the tenders now under consideration for the project are not too high. If built, the arch will describe a parabolic curve, and will be the largest span in existence, being840 feet, or 200 feet larger than that of the one at Clifton. A condition of the contract is that the bridge should be completed by the end of March, 1898. The plans provide for a double track electric road, as well as for a carriage way and road for foot passengers. One proposition is to take the materials of the present suspension bridge and build a suspension bridge on the site of the old one just above Queenston, the stringers and pieces of which now dangle weirdly in mid-air. This would connect the Gorge route with the Canadian Niagara Falls Park and River Railway at both ends, and by interchange traffic form a belt line which would be very convenient for the tourist, and could be made as profitable for the two companies

## THE REVOLVING FIELD TYPE OF ALTERNATING CURRENT GENERATOR.

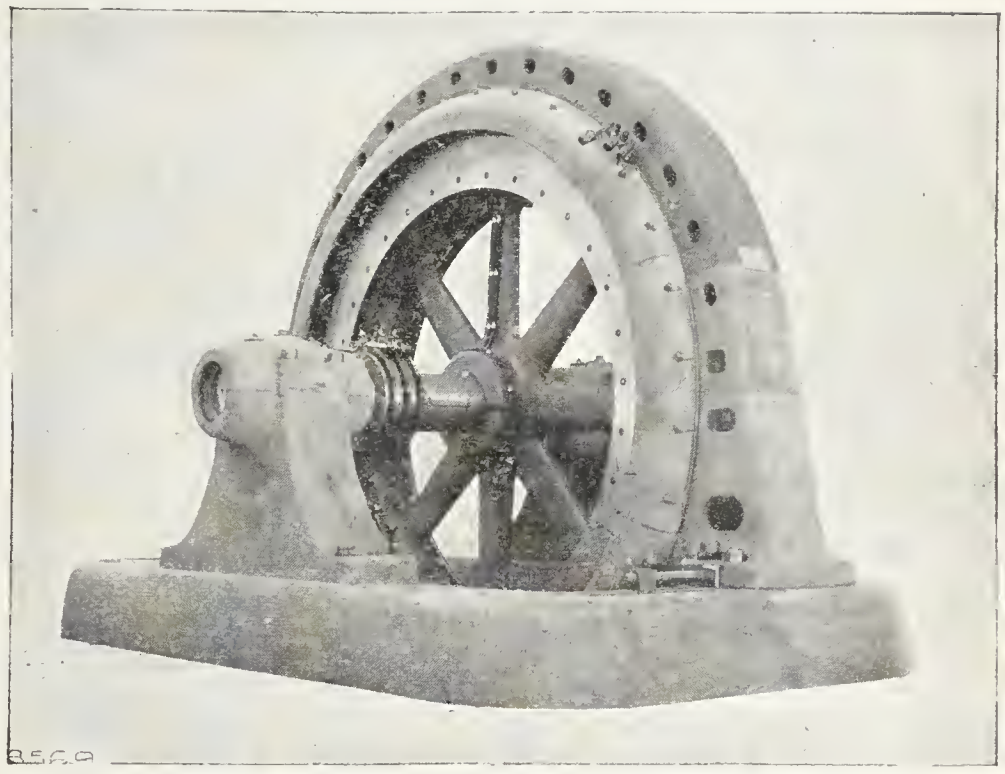
The development of the revolving field type of alternating-current generator and the standardization of a complete line, both for the monocyclic and three-phase systems, has of late occupied the attention of the engineering department of the General Electric Company with successful results. The alternators are designed for the standard frequency of 60 cycles and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the Canadian General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation, and the coils are covered and protected by shields. The base of the armature is of smooth cast-iron and the pedestals supporting the bearings are provided with spherical seats, which support the boxes and allow of perfect alignment.

The removable bearings are, of course, self-oiling, with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple of construction. It is merely an iron spider mounted on a shaft carrying a soft-steel ring, serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable, and in the larger sizes are wound with flat copper strips placed edgewise to allow of free egress from the coils of any heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency, these alternators combine good inherent regulation, and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator, properly so called. They come



The Revolving Field Alternating Current Generator.

under the head of extras. The temperature of the armature and the field windings does not rise above 45 degrees centigrade above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high-potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high-potential part of the alternator—the armature—being a stationary structure, can, it is claimed, be wound and insulated for much higher pressures than is desirable for revolving armatures, and the current can be fed directly into the line without the intermediary of step-up transformers. All the high-potential terminals are effectually insulated.

The revolving field alternators can be wound for the two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two phases.

During the past year the Canadian General Electric Company has sold a number of machines of this type, some for belt drive, but principally for direct connection to water wheels and steam engines. The illustration shows a 750-kilowatt, 40-pole, three-phase machine, running at 175 revolutions and delivering current at 4,400 volts. It is one of 12 which will be used on the Lachine Rapids installation.

Two more generators of the same size and type are being constructed for the 30-mile transmission plant of the West Kootenay Power and Light Company. For very low potential work this type is especially well adapted, two machines of 150 kilowatts capacity each having been in use for several months in the works of the Willson Carbide Company at Merritton, Ontario.

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**THE PUBLISHERS.**

## FREDERIC NICHOLLS, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

We noted in our issue of one year ago the election of Frederic Nicholls, second vice-president and general manager of the Canadian General Electric Co., to the presidency of the National Electric Light Association of the United States, which is numerically and otherwise the most powerful organization in the world devoted to the furtherance of electrical interests. It was to be expected by those who are acquainted with the personal force and executive ability which Mr. Nicholls brings to bear on the many business enterprises with which he is identified, that the affairs of the National Electric Light Association would under his *regime* be conducted with characteristic energy. The main difficulty with all associations of this kind is to maintain the serious interest of the members in those matters of current importance to deal with which as an organized body is their apparent reason for existence. In practice innocuous desuetude during three hundred and sixty-two days in the year, and a junket for the remaining three, is only too apt to be the actual *modus operandi*. The National Electric Light Association has admittedly suffered from this tendency in the past, but the improvement visible for the past few years has culminated under the presidency of Mr. Nicholls in a year of serious effort to deal with matters of vital moment to the electrical industry, and more particularly in the proceedings of the convention just closed at Niagara Falls, admitted on all sides to be the most successful in the history of the association.

The papers read before the convention were in most cases statements by recognized authorities upon topics of special interest. Amongst such may be mentioned the paper by Professor Elihu Thomson, on "Arc Lighting"; that by Arthur Wright, of Brighton, Eng., on "Profitable Extensions of Electricity Supply Stations"; that by Mr. Scott, on "Rotary Converters," and the lecture by L. B. Stillwell, on the "Application of Niagara Power." The attendance at the convention was the largest on record, reaching a total of over one thousand, and the proceedings throughout were of a most animated and interesting nature.

The American electrical press, in speaking of the convention, does so in terms which are highly complimentary to Mr. Nicholls as president of the association. We quote from the *Electrical Engineer*, of New York, as follows:

"In every respect the convention of the National Electric Light Association, at Niagara Falls last week, must be regarded as a great and brilliant success, far beyond that which was expected by those who had worked hardest to secure a happy result. The attendance was large; the papers were excellent and timely; the devotion to work was exemplary; harmony prevailed; the weather rang the changes so that the Falls could be seen in every aspect, and a good choice was made of officers to carry out the programme of usefulness to which the association has for some years past so consistently pledged itself. President Nicholls retired from office in a literal blaze of glory."

The *Engineer* further says. "To President Nicholls the association is under the deepest obligations for his devotion to duty and his skillful guidance of its affairs, and his term of office will always stand out in bright relief, no matter how much good work precedes it, nor how earnestly his successors strive to leave a brilliant record also."

*Electricity*, of New York, speaks thus: "President Nicholls made a model and dignified presiding officer. He far eclipsed his previous efforts, and it will be a high compliment indeed to any of his successors if it can be said of him that he equalled Mr. Nicholls as a presiding officer."

The *Western Electrician* of Chicago, in an article on President Nicholls' administration, believes that "it has been a great many years since the National Electric Light Association has had such an energetic president as the occupant of the office at this time, and it is but fitting in the closing days of his administration to call attention to the excellent character of the work he has done and the value of the service he has contributed to the association."

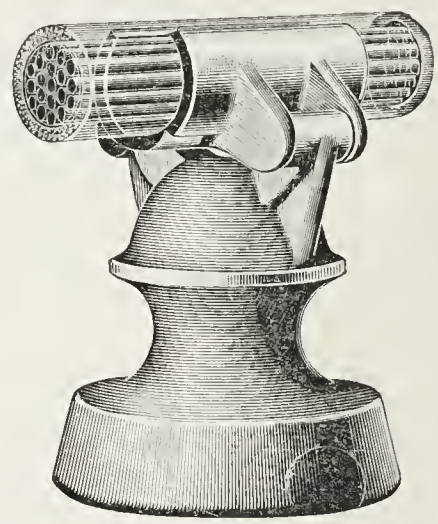
The *Electrical World* refers to the general character of the convention as follows: "While the social features and minor gaieties which characterize all conventions were not forgotten in this instance, the gathering was generally commented upon as the most business-like meeting that has yet been held by the association. The discussions of some of the papers were more than ordinarily valuable in bringing out the views of men whose opinions are entitled to respect, while the papers themselves were of a class calculated to instruct as well as to edify those who heard them. It is a pleasant task to be thus able to sum up the twentieth convention as the best in the history of the association, and still more pleasant to be able to prophesy that from all indications the twenty-first convention will be still more valuable and attractive to those who may have the pleasure and privilege to attend it."

The *Electrical Review*, of New York, has the following to say: "The success of the association during the past year under the wise and enterprising management of its retiring president, Frederic Nicholls, has been marked, highly satisfactory to all concerned. The administration has been at all times vigorous and well directed."

Altogether Mr. Nicholls in person, and the electrical public in Canada generally, have reason to feel most gratified at the manifest approval with which our American friends have greeted the occupancy on part of a representative Canadian of the president's chair of their most important electrical organization.

## TOGGLE-CLAMP FEED WIRE INSULATOR.

The usual method of attaching feed wires for electric railroads and electric light wires to their insulators consists in the use of a binding wire, a loose screw cap or hammering over the fingers which are furnished on either side of a groove in the top of the insulator. The use of a tire wire necessarily requires time and the risk of abrading or cutting through the insulating covering of the wire. A screw cap is liable to fall from the hands of the lineman or to cause other trouble on account of its size and nature. The hammering over on the wire of the metal retaining fingers is not to be considered good practice for the reason that the fingers are usually so stiff and brittle that in case the wire has afterwards to be removed the fingers are with difficulty opened or break off in the effort. The "toggle-clamp" feed wire insulator has been designed to provide an instantaneous fastening for the wire, with none of the disadvantages just mentioned, and every advantage in the way of instant removal without injury to the wire. The construction consists of two hinged parts as shown in the cut, so arranged that the



weight of the cable causes the two jaws to come closer together with a powerful toggle action. To insert the cable the jaws are opened by an upward movement and the cable is dropped into place. No other fastening is necessary. The cable is removed by simply lifting it out of the jaws, thus saving a great deal of time in installing, or shifting a line. The moulded insulation is protected with a malleable cast iron casing completely covering the exterior surface of the insulator. The toggle-clamp cable insulator is manufactured by the H. W. Johns Mfg. Co., 100 William st., New York.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain for May, and the five months ending May, 1896 and 1897:

| | Month of May, | | Five months ending May, | |
|---|---|---|---|---|
| | 1896 | 1897. | 1896. | 1897. |
| Hardware and cutlery | £6,097 | £7,730 | £27,493 | £25,647 |
| Pig iron | 3,179 | 563 | 7,780 | 1,018 |
| Bar, etc. | 2,141 | 316 | 6,299 | 4,205 |
| Railroad | 9,675 | 6,935 | 22,038 | 20,286 |
| Hoops, sheets, etc | 5,481 | 5,436 | 11,696 | 16,445 |
| Galvanized sheets | 3,006 | 3,975 | 15,672 | 15,998 |
| Tin plates | 13 753 | 8,652 | 56,119 | 80,972 |
| Cast, wrought, etc., iron | 6,776 | 3,882 | 21,568 | 14,965 |
| Old (for re-manufacture) | 2,680 | . . | 3,061 | 572 |
| Steel | 10,590 | 3,493 | 36,727 | 18,480 |
| Lead | 1,182 | 1,672 | 5,443 | 4,454 |
| Tin, unwrought | 1,559 | 1,609 | 7 074 | 8,925 |
| Cement | 3,393 | 1,825 | 10,365 | 4,778 |

THE International Luxfer Prism Company, Chicago, Ill., has been incorporated under the laws of the State of Illinois, with a capital of $1,000,000, commencing with $500, to manufacture and deal in iron, building materials, etc. John M. Ewin, Wm. A. Illsley, and W. M. Sturgis, Chicago, Ill.; Thos. W. Horn, Toronto, Ont.; W. H. Winslow, River Forest, Ill., are the incorporators.

mant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit. The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps. Where large generators are used and many circuits are run, the use of the individual circuit regulators becomes imperative.

I wish to call your attention to two pieces of mechanism. The first device is an automatic speed indicator and alarm, which points out the speed at which the machinery is running, and also rings a bell at every change of speed. The other is to close the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted on a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or spring being released, the frictions are pulled together and the gate is immediately closed.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that bane of water power users—anchor ice. If wheels are favorably situated, that is, if they are supplied from a large pond in which there is little or no current, and if there is an overflow or by-wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut-down can be prevented. But, if the wheels have no still pond from which to draw their water supply, it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of anchor ice.

* Abstract of a paper read before the Canadian Electrical Association.

## JUBILEE FOUNTAIN FOR MONTREAL.

It was a happy inspiration which moved Mr. Macaulay, of the Sun Life Assurance Co., to present a drinking fountain to the City of Montreal, as a memorial of the Queen's Jubilee. The accompanying illustration is a sketch reproduced from the *Witness*, of the proposed

SUN LIFE ASSURANCE CO.'S FOUNTAIN.

fountain, which will be a granite block surmounted by the figure of a sleeping lion, and having the inscription, "A tribute to Her Majesty, Queen Victoria," with the dates 1837-1897.

## DYNAMOMETER.

*Editor* CANADIAN ENGINEER.

SIR,—Kindly inform me if there is a car coupler that will test the draft of a locomotive, giving the draft in pounds. Where can it be got?

J. W. VAN NORMAN.

Peterboro, Ont., June 5th, 1897.

The apparatus you refer to is usually known as a Dynamometer and there are a number of them on the market. If you were to enquire of any of the leading makers of testing machines, as the Riehle Bros. Testing Machine Co., Philadelphia, Pa., they would be glad to afford you all the information possible on the subject.

## THE KINGSTON, ONT., SCHOOL OF MINING.

*Editor* CANADIAN ENGINEER:

SIR,—Kindly correct a mistake in your report, in a recent issue of your paper, of the number of students attending the School of Mining, Kingston. The number 502 as given in THE ENGINEER includes the 300 students who attended the ten outside classes. Thus, the total number of students attending classes in the School of Mining is 202. Long before it reaches 502 we shall need larger buildings.

I remain, yours, etc.,

W. L. GOODWIN.

## FIRES OF THE MONTH.

June 1st.—W. S. Stewart's planing mill, etc., Lucknow, Ont., also electric light plant. Loss, $15,000.——June 1st.—Carriage factory belonging to S. Siggins, Woodstock, Ont. Loss, $5,000.——June 3rd.—Firstbrook's box factory, Toronto; damages amounting to $200.——June 8th.—Cossit's foundry, Brockville, Ont., fire started in painting department. Fully covered by insurance.——June 12th.—Davidson & Campbell's planing mill, Niagara, Ont. Loss, $15,000.——June 15th.—Part of the east end abbattoir, Montreal. Loss, $35,000.——June 16th.—Canning factory at Tiverton, N.S. Loss, $3,000. — July 4th.—Fenderson & Co.'s saw mills, Sayabec, Que. Loss, $30,000; insurance, $8,000.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Kingston branch No. 10, C.A.S.E., has elected and installed the following officers for the current year: President, Fred. Simmons; vice president, Charles Asselstine; secretary, John L. Orr; treasurer, Charles Selby; conductor, Wm. H. Woodrow; door-keeper, Robert Bajus; trustees, Past President Sandford Donnelly and Jas. Blomley.

At the June meeting of Toronto No. 1, C.A.S.E., held in Engineers' Hall, the following officers were elected: President, Geo. C. Mooring; vice-president, Thos. Eversfield; rec. sec., John W. Marr, 28 Grant street, Toronto; financial sec., John G. Bain; treasurer, Samuel Thompson (acc.); conductor, George W. Thompson; door-keeper, T. Cadwell.

Arrangements are progressing for the forthcoming convention of the Canadian Association of Stationary Engineers at Brockville. By the constitution the convention should be held on the 17th and 18th August, but the date may be changed a day or two later, owing to arrangements that are being made for a special illumination of the islands. The exact date will be announced in our next number.

Albert E. Edkins, the popular inspector for the Boiler Inspection and Insurance Co., is slowly recovering from his recent serious illness, though not yet able to resume active duties. His many friends in the C.A.S.E. will be glad to see him among them again.

The Steam Boilers Act, which was a bill before the Dominion Parliament to provide for the examination of stationary engineers and the inspection of steam boilers, promoted by the members of Canadian nd Ontario Associations of Stationary Engineers, has been laid over till next session.

The following officers have been elected for Montreal No. 1, C.A.S.E.: President, Wm. Smyth; 1st vice-president, J. M. Boden; 2nd vice-president, P. McNaughton; secretary, Jas. O'Rourke; treasurer, J. E. Jones' conductor, J. Glennan; doorkeeper, J. Wilson; trustees, John J. York and Geo. Hunt

An association called the Railway Men's Air Brake Club has been ormed among the G.T.R. employees at Sarnia, the principal object of which is the study of the air brake. J. B. Wilson is president and Ed. Everett, secretary, and the association now numbers about 75 members, though it has only been in existence about five months. A similar organization called the G.T. Air Brake Mutual Association has been formed in London, Ont., with Thos. McHattie as president and Geo. Black, secretary.

A NEW horseless fire engine has been put into commission at Boston. It weighs 17,000 pounds, and will be handled by three men So far it has not been tried at a fire, but the captain who has charge of it is confident of its successful working.

* Abstract of a paper read before the Canadian Electrical Association,

# Industrial Notes.

A SAW MILL is to be erected in Wardner, near Vancouver, B.C.

C. R. CLOUGH & Co., Lennoxville, Que., are about to build a grist mill.

SMITH & MCLEOD have built a new sash and door factory at Vernon, B.C.

GEO. W. UPHAM, Woodstock, N.B., is building a new saw mill at Fredericton, N.B.

J. W. COOK, photographer, Caledonia, Ont., has invented another unrefillable bottle.

THE McClary Mfg. Co., London, Ont., will, it is said, establish a branch in Montreal.

THE Globe Furniture Co., Walkerville, Ont., is exporting its products to South Africa.

THE Gas and Water Company, Sherbrooke, Que., has empowered its directors to sell out to the city.

THE Queen City Oil Co. has made Brockville, Ont., one of its chief distributing points in Ontario.

R. SMITH & Co., Orillia, Ont., are putting a fifty-horse power engine and boiler in their stave mill.

A COUNTY bridge is to be built over the Nottawasaga river, on the town line between Sunnidale and Essa.

THE Toronto Aqueduct Power Company's bill has been killed for the session by the Railway Committee.

THE Macgregor-Gourlay Co., Galt, Ont., has had a Grand Trunk Railway siding put into their premises.

THE Malleable Iron Works, Toronto Junction, have closed down for an indefinite period, for stock taking.

THE Carleton Place, Ont., sawmills have closed down finally, as the supply of lumber has been exhausted.

WORK is proceeding on two bridges on the Trent and Table Rivers, on the Nanaimo-Comox road, B.C.

THE Hamilton Blast Furnace Co., Ltd., Hamilton, Ont.,· recently sold 800 tons of pig iron to a Montreal firm.

A. L. CASSON, of the Northwest Fixture Company, Seattle, Wash., proposes to build water works at Slocan, B.C.

LUKE MADIGAN, contractor, of Forest, Ont., has secured the contract for the $100,000 breakwater at Goderich, Ont.

THE Dominion Government has purchased a Sawyer-Massey road machine for use at the Ottawa experimental farm.

THE Nova Scotia Lumber Company has decided to rebuild its mill at Sherbrooke, N.S., recently destroyed by fire.

THE Lake of the Woods Milling Company will this year build elevators with a capacity of 200,000 bushels, in Manitoba.

NELSON, B.C., has bought the plant of the Consumers' Water Works Co. for $5,000. Possession to date from May 1st.

CHARLES C. HEARLE, Montreal, and John H. Bell, of New York, have formed a partnership for manufacturing boiler cleaners in Montreal.

GEO. MONTGOMERY is building at Dalhousie, N.B., a mill equipped with rotary, four shingle machines, planer and matcher and other machinery.

TALLMAN & SON, proprietors of the Beamsville Pressed Brick Co., have assigned to W. G. E. Boyd, Hamilton, Ont., for the benefit of creditors.

F. F. BUSTEED has prepared estimates for water works and electric light plant for the town of Fort William, calling for an expenditure of $48,000.

THE Renfrew town council has retained Willis Chipman, C.E , Toronto, as engineer for putting in a system of water-works and sewerage.

A. ROBB & SONS have purchased the Mumford Machine Works, at Hantsport, N.S., and will remove the machinery, etc., to Amherst, Nova Scotia.

IT is reported that the Gould Coupler Company, Buffalo, N Y., will erect a plant at Brantford, Ont., to manufacture its devices for the Canadian trade.

A DAM on Ponhook Lake, above Windsor, N.S., broke recently and swept down a quantity of timber, damaging dams and bridges to the amount of $100,000.

GANONG BROS., manufacturing confectioners, St. Stephen, N.B., have ordered a 100-horse-power Monarch Economic boiler from the Robb Engineering Company, Amherst, N.S.

A TWENTY-FIVE years contract for the water supply of St. Lambert's, Que., has been given to T. J. Drummond, of the Montreal Pipe Foundry Works, to be completed by Nov 1st.

J. LIVINGSTONE, Montreal, recently recovered $574 from the Bank du Peuple, being a balance of $1,500 which he charged for managing the business of Wm. Clendinneng & Son for three months.

ABOUT three hundred men are employed on the new works of the Bushnell Oil Co., at Sarnia, Ont. At the present rate of progress, the company will equip the plant in remarkably short time.

N. N. BENTLEY, Five Islands, N.S., has purchased Hill & French's lumber property at Ship Harbor. The Ship Harbor mills, which were burnt down a year ago, will not be rebuilt.

THE Nelson *Miner* says that a powder mill is to be established at Kaslo, B.C., as T. J. Watter and Raymond Meyer have decided to erect a plant that will have a capacity of 50,000 pounds a month.

C. & E. MILLER, exporters of West Australian hardwoods, have offered to supply blocks for paving 10 chains of street, in Toronto, free of charge, in order to demonstrate the suitability of this material for street paving.

THE National Convention of Master Plumbers of Canada was held in Toronto, July 1st, 2nd and 3rd. Pressure on our columns prevents more extended reference this month, but we hope to give our readers an account of the meeting in our next issue.

THE Universal Patent Developing Company, Limited, applies for a Dominion charter to deal in patent rights. Capital, $20,000. The incorporators are: L. H. Henault, A. S. Delisle, M. E. Lymburner, G. N. Ducharme, Ste. Cunegonde; J. Adam, Montreal.

LUNENBURG Foundry Company, Limited, applies for a Nova Scotia charter to manufacture stoves and machinery. Capital, $20,000. The incorporators are J. D. Sperry, Petite Riviere; Joseph Creighton, G. E. Sollows, W. L. Romkey and A. K. MacLean, Lunenburg, N.S.

THE Hamilton Bridge Co. has been awarded the contract for constructing bridges required in connection with the widening of the Queen street subway, Toronto, at $10,464 for a bridge to carry Grand Trunk Railway tracks, and $6,990 for carrying the Canadian Pacific tracks.

R. H. SMITH & Co., saw manufacturers, St. Catharines, Ont., are building an addition to their works in the shape of a malleable iron foundry for the manufacture of iron bedsteads. This will be the second firm making iron bedsteads in St. Catharines. The new foundry is to be in operation this month.

THE city council of St. Hyacinthe, Que., has appropriated $40,000 for the improvement of the waterworks. A new pumping station is to be built nearly a mile above the present one and beyond the city limits, and a high-duty pump, with a capacity of 2,000,000 gals. per day, will be put in. A filtering system will be adopted.

THE Government has decided to allow only 900 cu. feet of water per second to be drawn from the old Welland Canal; nearly half will be used by the company which is to supply power in Hamilton, Ont. The carbide factory and other manufacturers at Thorold, Merritton and St. Catharines have applied for the whole of the rest of the available supply.

THE arbitrators in the matter of the expropriation of the plant of the waterworks company by the town of Cornwall, have made a unanimous award placing the value of the plant and system at $78,620, which, with the ten per cent. allowed by law, brings the expropriating price up to $86,491.73. The cost of the arbitration will be about eight thousand dollars.

THE Dominion Elevator Company asks for incorporation with headquarters at Winnipeg. The capital stock of the company will be $200,000. Applicants are as follows: R. P. Roblin, G. Leary, J. Harris, D. J. Harris, D G. McBean, R. Muir, F. Phillips, W. W. McMillan, A. McBean, S. A. McGaw, Winnipeg, grain merchants, and H. S. Patterson, Portage la Prairie.

SALARIES in the Toronto City Engineer's Department have been reduced from $24,000 to $20,000. The salary list of the department in 1890, exclusive of the surveying and plumbing departments, totalled $41,932.22, which included $4,338.76 for the waterworks branch, work which is now all done in the department. Since then the reductions have gradually reached the figures named.

ALEXANDER FORD, an employee of the Bertram Engine Works, Toronto, had a narrow escape from death recently. An immense plate of steel was being hoisted by a derrick, when the chain broke,

and the sheet of metal fell straight downwards, cutting the flesh from the upper muscles at the front of Ford's legs and severely crushing his toes. Had he been an inch farther forward when the mishap occurred his skull would have been crushed in.

THE Halifax, N.S., *Chronicle* says that a new industry is soon to be started in Halifax county. Nearly two months ago an English syndicate sent an agent to Nova Scotia for the purpose of searching for a suitable material for the manufacture of terra cotta, and as the result of his research it is understood he has been instructed to purchase some property in Halifax county, build a factory and manufacture terra cotta. The output of the factory will be sold both in the United States and Canada.

THE statement presented at the meeting of the creditors of Paxton, Tate & Co., Port Perry, Ont., who have assigned to H. Barber, Toronto, showed liabilities of $47,018.69, and assets of $44,117.69, leaving a nominal deficiency of $2,901. There are over 100 creditors, in Toronto, Montreal, Hamilton, Galt and Port Perry principally. Most of the Port Perry creditors are for small amounts. The largest creditors are William McGill, of Port Perry, $17,200; Hon. John Dryden, Brooklin, $10,750; the Ontario Bank, $6,900, and the Western Bank, $3,735.03 The banks are secured. The direct liabilities are $37,746.04, the preferred $1,105.59, and the secured $8,169.06. In the statement of liabilities the principal creditors are as follows:—Polson Iron Works, Toronto, $492; Plews & Scott, Toronto, $225; James Holman, Toronto, $102; Hamilton Blast Furnace Co., Hamilton, $264.85; H. E. Plant, Montreal, $500; Frothingham & Workman, Montreal, $251.08; James Hutton & Co., $181.65; Mrs. E. Paxton, Whitby, $1,600; Dickson & Co., Peterboro', $218.64; Ottawa Saw Works, Ottawa, $141.45; Isaac Clemence, Seagrave, $100. The statement of assets is:—Stock, unencumbered, $1,150.75; encumbered, $34,101 96. Realty, land connected with and surrounding foundry, comprising about eight acres, $700; dwelling-house, occupied by George McLean, $400; foundry buildings and outsheds, $5,500, all valued at $6,600; dwelling-house and one acre, occupied by G. H. Dryden, $3,500, less mortgage of $1,545; bills receivable, $67.50; accounts, book debts, $242.48; total assets, $44,117.69. In the preferred claims the principal amounts are for taxes, 1896, $150.27; George McLean, $175; James Reid, $150; L. N. Walling, $130.26, these latter for wages. The secured liabilities are:—The Ontario Bank, $6,900, secured by first mortgage on land connected with foundry, together with all buildings, machinery tools and material on and about the premises; also dwelling-house occupied by George McLean; the Western Bank, $3,735.03, secured by customers' paper valued at about $4,500, and also a life policy in the Mutual Reserve for $10,000; Mrs. Mary Hodgson, $1,019.06, secured by chattel mortgage on house furniture and second mortgage on foundry, machinery, tools, etc.; Goldie & McCulloch, $250, secured by lien on engine. On the indirect liabilities Hon. John Dryden, of Brooklin, is a creditor for endorsement on paper held by the Ontario Bank as additional security for $6,900.

## Electric Flashes.

THE Montreal Park and Island Railway is now running cars to the Lachine wharf.

THE Watford, Ont., electric light company has recently installed a new plant.

WELLAND, ONT., is putting in an electrical fire alarm system A. Anderson, Toronto, has the contract.

H. SURTEES, son of the Ottawa city engineer, has been engaged as chief electrician of the Quebec Electric Street Railway.

THE Cornwall, Ont., Electric Street Railway has not been running a year, and already shows a profit of about five per cent.

PLANS are under consideration to extend the proposed Hamilton, Chedoke and Ancaster Electric Railway to Brantford, Ont.

STEPHEN SMITH, Toronto, has lost the use of his leg owing to the decay of the flesh, which had been exposed to X-ray photography.

THE Montreal Belt Line Railway Company intends to extend its line through Bout de l'Isle to Berthier. J. P. Mullarkey is managing director.

THE town council of Owen Sound has passed a resolution favoring the establishment of a municipal lighting plant, at a cost of about $27,000.

THE Carleton Place, Ont., council has concluded a bargain with the Bell Telephone Company to establish a general fire alarm system for the town.

THE Peterboro Electric Light and Power Co. is building a new central station this summer at which there will be about 1,000 horse-power (water) at their disposal.

THE Dundas, Ont., Light and Power Company has offered to furnish the town of Dundas with 25 street lights of 1,600 candle power for 300 nights a year, at $61.25 each.

THE St. Thomas street railway is to be converted into an electric system, says the Aylmer *Sun*. Col. Stacey, owner of the present road and J. H. Still, are interested in the undertaking.

THE Cornwall Electric Railway is now in good running, with six or eight motor cars The company is now considering the question of extending its system to some neighboring villages.

THE Minister of Public Works, Hon. J. I. Tarte, has prepared plans for extending the electric plant in the Parliament Buildings at Ottawa to supply light and also power for pumping.

THE Chambly electric power works are making rapid progress. Some 500 men are employed in this enterprise, and Peter Lyall, the contractor, hopes to have the dam finished this fall.

SADLER & HAWORTH, belting manufacturers, Montreal and Toronto, have just furnished the Hull and Aylmer Electric Railroad with two double leather main driving belts one hundred and thirty feet long and thirty-six inches wide.

THE Robb Engineering Co. are building two 300 horse-power tandem compound engines, one for the Halifax Electric Tramway Co., and the other for the St. John Railway Co. This makes five of these engines sold to the Halifax company.

GANANOQUE, ONT., has sixteen arc and eight incandescent lights, costing $1,216 a year, or $70 for each arc and $12 for each incandescent. Under a new five years' contract there will be twenty-one arcs for $1,200, and nine incandescents for $80; total, $1,280.

THE Stevens Manufacturing Co., London, Ont., have recently gone into the manufacture of dynamos, motors, transformers, switches, etc. They are the sole manufacturers in Canada under the Easton patents, and are already doing a large trade throughout Ontario.

IT is estimated that 4,000 16-candle power lamps will be required to light the new Toronto municipal buildings. The city engineer, Mr. Keating, makes an estimate of $45,000 to instal the necessary plant at the waterworks pumping station, and $5,000 a year for maintenance.

ARRANGEMENTS are being made by which Her Majesty Queen Victoria will start the electric works of the Lachine Hydraulic and Land Company at Lachine Rapids, Que. This will be done by means of the Atlantic cable, Her Majesty simply touching the electric button at Windsor Castle.

J. A. BAILEY and A. Lane, of Sandusky, O., were in Hamilton, Ont., recently, in the interests of the Partridge Carbon Company which is looking for a location for a Canadian branch of its factory. The company's specialty is an electric light carbon, which they claim is superior to those now in use.

THE Lachine Rapids Hydraulic & Land Company are now in shape for supplying power and light to Montreal, having practically inaugurated their service on Jubilee Day. They are supplying power, at $40 to $70 per h.p. per year, and incandescent lighting at from one-half cent per hour up, by meter.

IN the item in last issue referring to the installation of an electric light at Perrin's biscuit factory, London, Ont., it was stated that the whole installation was made by the Rogers Electric Co. We are informed that the plant was supplied by the Electrical Construction Co., of London, the wiring only being done by the Rogers Electric Company.

THE Montreal Street Railway Company will, it is said, adopt a new style of trolley pole. The present ones, composed of round wrought-iron piping, are to be gradually removed and replaced by small towers of angle steel riveted together. It is expected that being openwork they will more easily resist the storms of the winter, as the wind can blow through their interstices.

THE news that the Queen has approved the formation of a new volunteer corps in England, to be called "The Electrical Engineers, Royal Engineers (Volunteers)," will be pleasing to all of our readers. The idea of forming such a body of electrical engineers originated from Dr. John Hopkinson during the early months of 1896, when the Venezuelan dispute was before the country.

THE directors of the British Columbia Electric Railways, Ltd., which has taken over the business and systems of the electric railways of Victoria city, Vancouver and Westminster, are: F. S. Barnard, Horne Payne, R. M. H. Payne, A. C. Mitchell-Innes, R. N. Laurie, G. P. Norton, and R. S. Sperling. Qualification, £500; remuneration, £1,000 per annum and a share in profits.

THE Montreal Street Railway Co. has erected two miniature Eiffel towers of angle steel a hundred and sixty-five feet high. They are nineteen feet square at the base, and fifteen inches square at the top. They rest on a foundation of concrete twelve feet deep. These towers will support a cable across the Lachine Canal into Point St. Charles, to supply power to the company's line.

FIVE companies tendered for the construction of the Chatham, Ont., civic electric lighting plant. They were the Stephenson Company, of London; John Abell, Toronto; the Thompson Electric Company, Hamilton; the Royal Electric Company, Montreal, and the Harris Electric Company, Detroit, U.S.A. A number of them tender only for the electrical apparatus, wiring, etc., while others make their tender cover everything required.

AT a recent special meeting of the town council of Niagara Falls, Ont, a by-law was introduced giving the electric-car company holding the present charter for the horse-car line a 20-year charter, with the privilege of running over the same route, with a few extensions, providing the company put in motive power other than horses or steam. The company must act within thirty days of the passing of the by-law and complete the line within sixty days.

NEARLY 400 people registered their attendance at the convention of the National Electric Light Association at Niagara Falls, N. Y. June 8th—10th. Details in next issue. Among whom were noted the following: F. C. Armstrong, Toronto; T. A. Badger, jr., Quebec; E. B. Biggar (CANADIAN ENGINEER); F. A. Bowman, New Glasgow, N.S.; John Carroll, Montreal; Prof. C. A. Carus-Wilson, Montreal; E. E. Cary, St. Catharines; E. T. Freeman, Halifax, N.S.; W. A. Johnson, Toronto; J. A. Kammerer, Toronto; R. S. Kelsch, Montreal; John Langton, Toronto; Frank LeBlond, Niagara Falls, Ont.; E. D. McCormack, Toronto; Charles Morton, Montreal; John Murphy Ottawa; Frederic Nicholls, Geo. A. Powell, St. Catharines, Ont.; J. F. Rothsay, Niagara Falls, Ont.; A. E. Smaill, Montreal; W. McLea Walbank, Montreal; Geo. W. Watts, Toronto.

THE West Kootenay Power and Light Company, Limited, which was recently organized for the purpose of developing the magnificent water power available at the Falls of the Kootenay, ten miles from Nelson, B.C., has just closed a contract for the hydraulic and electrical machinery, to develop 2,000 horse-power, immediately, the ultimate scope of the undertaking being the utilization of the full power of the river at this point, estimated at from 8,000 to 10,000 horse-power. At the head of the company is Sir Charles Ross, Bart., who is largely interested in mining properties, and with him are associated C. R Hosmer, Frank Paul, and other influential and well-known capitalists. The services of Robert Jamieson, formerly engineer in charge of the Lillooet, Fraser River and Cariboo Gold Fields Co., Limited, have been secured to supervise the entire undertaking, and his wide experience in mining engineering work of all kinds, will insure the most efficient working out of all the detail appliances necessary to apply the electric power in the most satisfactory manner for mining work. Some interesting details as to the electrical features of the scheme have been made known. The apparatus will be of the three-phase type manufactured by the General Electric Company, Limited, and the generators of the revolving field type, similar to those now being installed in the large power plant of the Lachine Rapids Hydraulic and Land Company at Montreal. The initial generating plant will consist of two machines, having a capacity of 1,000 horse-power each, from which the current will pass through step-up transformers, raising it to 20,000 volts, the highest pressure as yet used on any electrical transmission line. At this high pressure, the energy will be carried to a sub-station at Rossland, a distance of thirty miles, where it will be reduced to a pressure of 2,000 volts for transmission to the motors used in connection with the different mining enterprises. The electric power will be used for operating tramways, hoists, pumps, ventilators, stamp mills, drills, etc., and will be sold at a price which, in comparison with the present high cost of power generated from coal, means a greatly reduced expenditure in this direction by the different mining companies The machinery is now in course of construction, and the plant is to be in full operation early in the Fall.

## A SAFETY VALVE PROBLEM.

*Editor* CANADIAN ENGINEER.

SIR,—Kindly answer this safety-valve question in the July issue of your valuable paper: What is the weight required on the end of the lever, not considering the weight of the valve stem or lever, when the length of the lever is 36 inches, the diameter of valve is 3 inches, the fulcrum is 3 inches, and the steam pressure 125 pounds?

THREE ENGINEERS.

Under the conditions stated, viz., lever, 36 ins; diameter of valve, 3 inches; fulcrum, 3 inches; pressure, 125 lbs., the weight required on the lever is 76.542 lbs.—[EDITOR.

AT a public meeting held recently in Rat Portage, Ont., it was resolved that water works were at once necessary for the health of the town. T. R. Deacon is town engineer.

# Railway Matters.

RICHARD WOOD has been appointed receiver of the St. Catharines and Niagara Central Railway.

THE C P.R. has arranged for the construction of 1,000 new freight cars at their various shops.

PEMBROKE, ONT., has passed a by-law to grant a bonus of $20,000 to the Pembroke Southern Railway.

QUITE a number of Canadian Pacific workmen have been sent from Toronto Junction to Perth, Ont., to assist in the construction of 200 new freight cars.

THE C.P.R. have received a number of new refrigerator cars from their Perth workshops. Five of them have been sent to Weehawken, N.J., to load butter for Australia.

THE Richelieu & Ontario Navigation Co. has issued a very neat pamphlet showing to its friends the beauties and attractions of the Ontario waterways. Some interesting chapters are devoted to the lovely spots between Montreal, Toronto and Hamilton.

IT is reported that General Manager C. M Hays, of the Grand Trunk Railway, has issued an order to the effect that section foremen must dispense with the services of relatives working under them, and that relatives must not in future be employed by them.

A. FACKNEY has contracted for the erection of car-houses, etc., for the Quebec District Railway Company on St. John, d'Aiguillon, Racine and Richelieu streets, Quebec, the building to be 176 by 116 feet, two stories, in brick and stone with mansard roof, at a cost of $25,000.

ON June 1st the Dominion Government officials stopped the running of trains on the Baie des Chaleurs Railway, which has been operated as a branch of the Intercolonial since January last, and the road was handed over to the representatives of the Atlantic & Lake Superior Railway Company.

THE Railway Y.M.C.A., which was opened a short time ago in roomy quarters, Front street and Spadina avenue, Toronto, by General Manager C. M. Hays and a number of distinguished men and philanthropists, is doing a splendid work. There is quite a good library in the association rooms.

D. F. BURK, Port Arthur, Ont., has secured an injunction restraining the provisional directorate of the Ontario Rainy River Railway receiving a first payment of $7,000 in the sale of the Ontario Rainy River Railway. The purchasers are Wm. Mackenzie, president of the Toronto Street Railway Company, and his brother, R. Mackenzie.

THE C.P.R. has let the contract for the construction of the Slocan valley branch of the Columbia and Kootenay system. McVey & Poupore will do the grading from Slocan Crossing to within sixteen miles of Slocan. The rest of the work will be done by McLean Brothers, of Nelson. About 1,000 men will be employed this summer establishing the necessary grade, constructing bridges and putting down the rails.

W. J. HANLY, Toronto, will have charge of construction on the Crow's Nest Pass Railway when it is begun. Mr. Hanly has done a good deal of work for the Canadian Pacific, and was, in fact, the first superintendent of the Canadian Pacific before the formation of the present company, and built the Pembroke branch, and also the Kingston and Pembroke. On the main line, Mr. Hanly built the section between Rat Portage and Selkirk, Man, a distance of 150 miles, and likewise from Port Moody to Griffin Lake, 350 miles.

JOSEPH HOBSON, chief engineer of the Grand Trunk Railway System, having been assigned the entire charge of the construction of the new Victoria bridge, it has been decided that, to enable him to devote his personal attention to this and other important new works of the company, taking effect July 1st, the immediate supervision of the maintenance of track, buildings, water stations and wooden bridges will be placed under the jurisdiction of the superintendents of the respective divisions, who will report to and receive their instructions from the general superintendent, F. H McGuigan. The chief engineer will continue in charge of the St. Clair tunnel, all iron bridges, masonry and signals and interlocking. He will also have the direction and supervision of all contract work, the preparation of plans, specifications and estimates for new work, and the custody of original maps and profiles of the roads comprising the system.

# Mining Matters.

M. Beatty & Sons, manufacturers of contractors' plant and mining machinery, Welland, Ont., have appointed E. Leonard & Sons their agents in Montreal.

The following are the duties upon ore brought down by the Dominion Government: (a) On nickel contained in matte or in the ore, or in any crude or partially manufactured state, and upon copper contained in any matte or ore, which also contains nickel, when exported from Canada, upon such nickel an export duty not exceeding 10c. per pound, and upon such copper an export duty not exceeding two cents per pound. (b) On ores which contain copper or any metal other than nickel or lead, when exported from Canada, an export duty not exceeding 15 per cent. on the value of the said ores. (c) On lead ores, and on lead and silver ores, when exported from Canada to a country which imposes an import duty on lead in bar or in the form of pig lead in excess of the import duty on lead contained in lead ores, or in lead and silver ores, an export duty on the lead containing the ores so exported from Canada to an amount per pound equivalent to such excess.

A discovery of black granite is said to have been made at Welsford, N.B. The property has been acquired by a Bridgewater, Nova Scotia, firm, and they will commence the erection of polishing works.

The successful operation of the new calcining and refining furnaces at the Nelson, B.C., copper mines, has been a matter of general congratulation, and the fineness of the copper produced has been steadily improved. The grade now produced is 98 and 99 per cent. copper, silver and gold, and as much as fifteen tons have been taken from the refining furnace from a single charge.

This season there will be four members of the Canadian Geological Survey at work in Nova Scotia. Dr. Ellis, Mr. Fletcher and Dr. Ami will visit the coal measures and complete surveys that have been going on for some time. Mr. Fairbault will resume his study of the gold-bearing rocks along the Atlantic coasts of that province.

The Hawk Bay mine in western Ontario is now equipped with a fine plant, the machinery consisting of two 35 h.p. boilers, a three drill air compressor, three Rand drills, a 17 x 10 double cylinder hoisting engine, and a single cylinder hoisting engine.

A new dredge is to be put in place at Big Bar, on the Fraser River, where, H. O. Bowe says, a bucketful of gravel yielded $2 in gold.

Wm. Ogilvie, D.L S, gives some startling information about the richness of the gold-bearing gravel in the Klondike region on the Yukon. Placer mining is being carried on in Bonanza Creek, an affluent of the Klondike, and the workings must be exceptionally rich, for three men worked out $75 in four hours, and a $12 nugget has also been found, showing that there is coarse gold and plenty of it. It is claimed that from $100 to $500 a day can be made off the ground that has been prospected. One man washed out a single pan of dirt on one of the claims and found $14 25 in it. The average on that claim, it is reported, is $5 to $7 per pan, with 5 feet of pay dirt and the width yet undetermined; but it is known to be at least 30 feet, so that, figuring at nine to ten pans to the cubic foot, on a length of 500 feet, the result would be nearly $4,000,000, at $5 per pan. Another claim has been prospected to such an extent that it is known there is about 5 feet of pay dirt, averaging $2 per pan, and of a width of not less than 30 feet.

# Marine News.

The Dominion Atlantic Railway Co. is building a wharf at Yarmouth, N.S.

An attempt was made to burn the steamer "Lakeside," at St. Catharines, Ont., recently.

The Ontario Government has granted two leases for the ferry business between Kingston and the islands.

The Rondeau and Cleveland Steamship Company, Limited, has applied for incorporation. Chief place of business, Chatham, Ont.; capital, $20,000.

The Richelieu and Ontario Navigation Co.'s steamer "Corsican," which was practically rebuilt last winter, is now one of the finest boats on the lake and river route.

The contract of Wm. Davis & Sons at Cardinal, on the St. Lawrence Canal, will involve the making of a cut half a mile long, 60 feet deep and about 300 feet wide.

The contract for building the wharf at Pugwash, N.S., for which $10,000 were placed in the estimates in the last session of Parliament, has been awarded to McDonald & Moffat, North Sydney, C.B.

The Canadian Pacific Railway Company will add to its fleet on the Columbia by building an express boat for carrying passengers, mail and express. The keel of the new boat was recently laid at Nakusp. When completed, it is expected that the boat will be the fastest craft in any of the inland waters of the North-West, and it is expected to make the time from Trail to Arrowhead in 24 hours, equal to 19 miles an hour. The boat will be christened "The Flyer."

After being bitterly fought, step by step, through the courts for nearly a score of years, a decision has been handed down in the United States Supreme Court, in the case of the owners of the barges "Eldorado," "George W. Wesley" and "Bay City," against the owners of the steamer "J. B. Donaldson." The court held that when a steamer is compelled to desert her tow in a storm for self preservation she cannot be held liable for any general average loss sustained by the tow.

# Personal.

J. F. Millar, of Morrisburg, Ont., recently visited Japan as agent for the Leonard & Ellis Oil Company.

Joseph McNeil, an employee of the Nova Scotia Steel Co. at Ferrona, N.S., was killed recently by falling from a moving train.

C. H. Rust, assistant city engineer, Toronto, has been appointed a member of the council of the Canadian Society of Civil Engineers.

The fly wheel of the engine in the St. John, N.B., street railway power-house burst recently, seriously injuring Chas. Sullivan, who was in charge.

Elisha Stewart, O.L.S., Collingwood, Ont., has been appointed by the Ontario Government as chief of the Bureau of Mines Department, to be established at Rat Portage, Ont.

Wm. Davidson, Sherbrooke, Que., who recently graduated with high honors from Columbia College, New York, has been sent to Japan by the Rand Drill Company to erect a large mining plant.

Sydney M. Johnson, B.A., Sc., P.L.S., and J. E. McAllister, B.A., Sc., have opened an office in Trail, B.C., where as Johnson & McAllister they do business as surveyors, assayers and mining engineers.

Alexander R. Goldie, of Goldie & McCulloch, Galt, Ont., was recently married to Miss Nora Gibson, daughter of the late James Gibson, at the residence of the bride's mother, "Spring Valley Farm," Berlin, Ont.

D. J. Waterous, of the Waterous Engine Works Company, Brantford, Ont., was polishing the chain of his bicycle recently on an emery wheel. While working, the chain in some manner was caught and jerked violently, and winding round his arm tore the coat sleeve off and inflicted painful bruises and cuts all the way up his arm.

R. O. King, B.A.Sc., Toronto, who graduated from McGill University with the British Association Gold Medal in 1895, and whose portrait appeared in The Canadian Engineer at the time, has just been appointed to the William Whitney Fellowship, at Harvard University, where Mr. King has been taking a course in the graduate school. Mr. King was born at Port Hope, Ont., 23 years ago, and received his earliest education at Georgetown, Ont.

Whilst superintending the construction of machinery at Montmorency Falls, not long ago, Omer Carrier, of the firm of Carrier, Laine & Co., Levis, Que., accidentally touched a live wire. He was knocked down, but rising again he said to those around him, "Oh, it is nothing." He sank to the ground again, and all efforts to revive him were fruitless. Mr. Carrier, who was 27 years of age, and leaves a widow and two children, is much regretted by a large circle of friends.

J. R. Roy, C.E., formerly of Montreal, who is in the Public Works Department of Canada, has recently been appointed to fill the important position of resident engineer in the Province of British Columbia, where he will have the full charge of all the work of the department in that province. The chief provincial office of the department has recently been moved from Victoria to New Westminster, from whence Mr. Roy will leave early in July for a tour of inspection of the other offices of the department in the province. A very important part of Mr. Roy's work has been the establishing, at different points along the Fraser River, of gauges to record its rise and fall. The state of the river will be telegraphed to points which have before now suffered by inundations, and farmers will in future have due warning.

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The 29th annual convention of the American Society of Civil Engineers opened in Quebec, July 1st.

# The Canadian Engineer

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

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### CHAPTER II.

TRAIN RESISTANCES AND THEIR COST.

ART. 6.—TRAIN RESISTANCES.—(*Continued*).

*(C.)* CURVE RESISTANCES.

In America a curve is designated by the number of degrees which a hundred foot chord subtends at the centre of the circle, thus a 1° curve subtends 1°, etc. The radius of a 1° curve=5730 feet, and the radius of a $D°$ curve is (approx.)$=\frac{5730}{D}$ feet.

The centrifugal force of a train passing around a curve at $v$ feet per second $= C = \frac{Wv^2}{gr}$ ..... (6)

If we change $v$ into $V$ (miles per hour) and $r$ into $D$ (degree of curve) we will get $C = \frac{W}{32.2} \times \frac{V^2(1.467)^2}{1} \times \frac{D}{5730} = \frac{WV^2D}{85666}$ ..... (7)

Now, in order to counterbalance this force, the outer rails, on curves, are elevated sufficiently above the inner ones (super-elevation) to make the resultant of gravity and centrifugal force to pass midway between the rails and at right angles to the track, and the floor of the car will then be parallel to the track (see Fig. 3). It is evident from the figure that by similar triangles

$$\frac{\text{Super-elevation}}{\text{Gauge}} = \frac{\text{Centrifugal Force}}{\text{Weight}} \quad \text{or}$$

$$\text{Elevation} = E = G \times \frac{C}{W} = \frac{59V^2D}{85666} \quad \{\text{from (7)}\} \ldots\ldots\ldots (8)$$

by which it will be seen that the required elevation varies directly with the degree of curve and with the square of the velocity.

For a 1° curve, $E = \frac{59}{85666} V^2 = .00069\ V^2$ ..... (9)

TABLE VII.

TABLE OF SUPER-ELEVATION OF OUTER RAIL, PER DEGREE, FOR DIFFERENT VELOCITIES.

| $V$ (miles per hour) | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $E$ (inches) | .02 | .07 | .15 | .28 | .43 | .62 | .84 | 1.10 | 1.40 | 1.72 | 2.48 | 3.36 | 4.40 | 5.60 | 6.90 |

It is evident, however, that only at that particular speed for which the outer rail is elevated will the car body be normal to the track. At slower speeds, the inner springs will compress and outer ones extend somewhat, while for higher speeds the reverse will be the case. The custom, on general traffic roads, is to elevate for medium passenger speeds of say 30 miles per hour, which is slightly over one-half inch per degree, while on high speed passenger tracks of roads having only light curves, particularly, elevations of as much as one inch per degree are common.

It may be assumed that a safe maximum riding speed will exist when the car body becomes level. Wellington's assumption is that the weight of a passenger-car will compress its springs six inches, and that the distance of the centre of gravity of the car body above the springs is equal to the distance of the springs apart giving equal turning couples. The total centrifugal force necessary for this action will be approximated.

$$C = \frac{WV_1^2D}{85666} = \left(\frac{E}{6} \times \frac{W}{2}\right) + \left(\frac{WV^2D}{85666}\right) = \frac{59V^2DW}{12 \times 85666} + \frac{WV^2D}{85666}$$

or, eliminating, $V_1^2 = \left(\frac{59}{12} + 1\right) V^2 = \frac{71}{12} V^2$

$\therefore V_1 = 2.43V$ ..... (10).

(where $V_1$ = speed to bring car body level.)

( $V$ = speed for which track is elevated.)

This speed is, evidently, independent of the curvature.

The speed at which trains, running on tracks properly elevated, will overturn, is very high, and not of sufficient interest to calculate, and will depend on the amount of compression possible in the springs before the car body comes down on the buffers, and upon the amount of elevation per degree of curve given to the track.

Those roads which have sharp curves will always run at moderate speeds around them; the sharper the curve the less the speed. This fact and practical ballasting difficulties have limited the total super-elevation to about six or eight inches, which corresponds to a curve of 8° to 12°, depending on the speeds expected, on curves of greater sharpness the lessened speeds will require less elevation per degree.

The position which a short rigid truck assumes in passing around a curve is as in Fig. 4; the front outer wheel flange against the rail head, and the rear wheels radial to the curve and midway between the rails, unless

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

the curve is so sharp or the truck so long as to render this impossible, when the rear inner wheel flange will also jam against the rail. This, however, will not happen with a 5-foot American truck on any ordinary curve. Wheels are still made with a modified coning (see chapter on track), but this is intended only to provide for future wear, as it is proven that it does not aid in passing around curves by the whole truck moving to the outside, as was formerly supposed to happen.

In passing around a curve the wheels slip in two directions, besides flange friction: (1) Longitudinal, due to the inner and outer rails being of different lengths; (2), lateral, due to a continuous sidewise movement in changing direction. This latter is confined to the front axle, as the rear one keeps radial always to the curve. The amount of these slippages are calculated, if necessary, as follows: (See Fig. 5.)

(1) Longitudinal slippage $= \frac{\text{gauge}}{\text{radius}} \times$ distance travelled.

(2) Lateral slippage = sin. angle $a \times$ distance travelled for 5-foot American truck, sin. $a$ = .00087, and lateral slip = .00087 $d$.

| | | | |
|---|---|---|---|
| 0+ | miles per | hour..... | .242 |
| 7 | " | " ..... | .088 |
| 13 | " | " ..... | .072 |
| 34 | " | " ..... | .065 |
| 52 | " | " ... ..... | .040 |

And as anything in the above table is nearly at zero-miles per hour, we can be safe in assuming a coefficient for this slippage at from .24 to .20, with a tendency to get less as the curve gets sharper (contrary to earlier notions on curve resistances.)

In addition to these slippages we have flange friction (see Fig. 6). When the rail is new the line of pressure is nearly a point; the two forces acting on the front outer wheel are the load on the wheel and a lateral horizontal force sufficient to cause the slippages to take place, which have already been mentioned. If we take the coefficient of friction at .24, then there will be a total force of .72 $\angle$. This is combined with the vertical force $\angle$ to give a resultant force 1.23 $\angle$, acting as shown in Fig. 6. This causes the radius of the outer wheel at its line of bearing to be $\frac{1}{8}$ inch to $\frac{1}{4}$ inch larger than the inner one, and a consequent slippage takes place which is constant for all curves. The amount of friction caused by this increases rapidly as

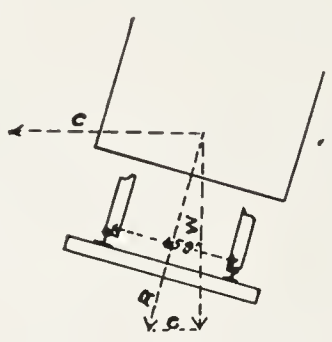


Fig. 3.

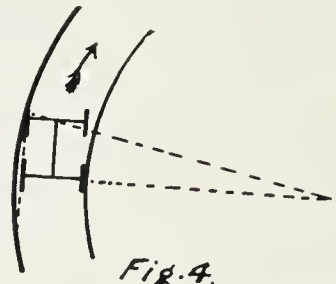


Fig. 4.

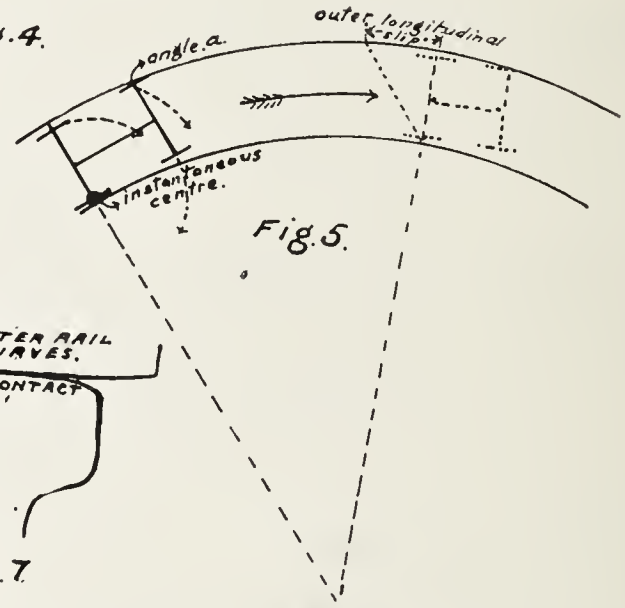


Fig. 5.

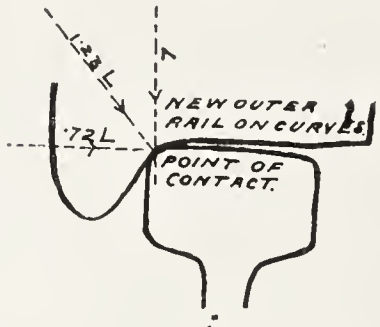


Fig. 6.

Fig. 7.

It will be seen by Fig. 5 that the truck is turning continually around the inner rear wheel as a centre, and the aggregate slippages are as follows:

(1) Rear inner wheel does not slip at all.

(2) Rear outer wheel slips longitudinally.

(3) Front inner wheel slips laterally.

(4) Front outer wheel slips laterally and longitudinally.

TABLE VIII.

| | 1° Curve Ft. | 5° Curve. Ft. | 10° Curve. Ft. | 20° Curve. Ft. |
|---|---|---|---|---|
| Average slippage per wheel, per foot..... | .00073 | .00363 | .00730 | .0145 |
| Average velocity of slippage (in feet per second), train going at 30 miles per hour..... | .043 | .21 | .43 | .86 |
| Ditto (miles per hour)..... | .029 | .145 | .29 | .54 |

It is noticeable that the slipping is at a very low rate, being for ordinary curves and speeds only a fraction of one mile per hour, and which ever wheel starts slipping, whether inner or outer, will continue to do so around any particular curve; but this is immaterial.

Now, the coefficient of sliding friction between steel tires and steel rails under different velocities is about as follows:

the rail becomes worn and the surface of contact increases. (See Fig. 7). So that any estimate of its actual amount will be useless unless we know the exact condition of the rail head and wheel flange.

Wellington estimates it to be 1 lb. per ton for new rails, with a considerable addition as rails become worn. This will not vary with the curvature, and is to be added to the amount calculated from Table VIII., which, taking the coefficient of friction at .24, amounts to .35 lbs. per ton per degree. The results of experiments confirm the theory that the total amount varies from $\frac{1}{3}$ to $\frac{2}{3}$ lbs. per ton per degree, increasing as the condition of the rail becomes worse, and the surface of contact, for flange friction, greater. The total curve resistance does not increase quite as fast as the curvature when the rails are new, but as the rails become worn the opposite is the case; and as the rails on curves become worn more quickly the sharper the curve, it is probably safe, as an average, for ordinary use, to assume that curve resistance varies with the curvature, and equals $\frac{1}{2}$ lb. per ton per degree. Referring back to grade and level tangent resistances, we see that—

6 lbs. per ton = resistance on 12° curve.
= resistance on $\frac{3}{10}$% grade.
= level tangent resistance at low speed.

Or that a 12° curve doubles the level resistance, or that a 1° curve is equal in train resistance to a .025%g rade ; strictly, therefore, we should lessen gradients on curves by .025 for each degree of curve, to compensate for curve resistance, but this would be scarcely enough, for whenever a train is nearly stalled, curve resistances due to low speed will be much higher, and if the train is once stalled it will be hard to start again on a curve just barely compensated. For this reason it is customary to compensate for curves at a higher rate than is theoretically necessary, the usual amounts being .04 to .05 per degree of curve, depending on how valuable a few feet are, in elevation, on maximum grades.

ART. 7.—THE COST OF TRAIN RESISTANCES.

It must not be supposed that the expenses of operating a road vary with the total train resistances found according to the rules given in Art. 6. Even the fuel consumed is only affected partially by variation in train resistances; some are affected very much, as car repairs and rail wear, while others, such as maintenance, general expenses, etc., are hardly affected at all.

(*A*) *Cost of Curve Resistances.*—It is estimated that 36 per cent. of the working expenses vary with the curve resistances, and taking the cost of a train mile at 90 cents, and a continuous 12° curve for a mile = 633° curvature, = one mile of level tangent resistances; then, the cost of operating a train each way for a year around 1° of curvature $= 365 \times 2 \times \frac{90}{633} \times 36$ per cent. $= 37\frac{3}{10}$ cents, therefore, we are justified in spending $\frac{100}{5} \times 37.3$ cents = $7.46 per daily train, during construction, in eliminating each degree of curvature with money at 5 per cent., any number of trains per day, or degrees of curve in direct proportion, from which it is evident that the worst features of sharp and heavy curves are more questions of appearance, comfort and safety, than of actual cost in operating, especially as the case is always one of more or less curvature only, and not a question of curves or no curves.

With roads expecting light traffic and heavy grading, it is evident that a very great amount of curvature will be justified; and then, too, it must be remembered, that it is the total angle of a curve and not its sharpness that counts in the total train resistances; the only objections to sharp curves are the slightly increased danger of derailment, the necessary slackening down from very high speeds, the slight lengthening in distance, and the sentiment of the public against them.

(*B*) *The Cost of Grade Resistances.*—Grades must be viewed from two standpoints: first, as so many feet of rise and fall, up and down which the trains must be carried; and second, as the limiting features to the maximum load which a given engine can haul at a low speed over a freight engine division. Under the first heading Wellington divides them into three classes:

(1) Those which are so light or short as to be passed over with uniform steam on and no brakes, the speed only, fluctuating. Such grades cost nothing appreciable more to operate than level grades, as the trains going each way in a day gain as much energy as they lose. These grades would be, roughly, anything less than 0.5 per cent.

(2) Those in which steam is cut off in descending, but which do not need brakes in descending nor sand in ascending. It is estimated that one foot of rise and fall, per daily train per year on this class of grade, costs:

Eighty-four cents, if a minor grade, which equals $16.80 capitalized; $1.67, if a maximum grade, which equals $33.40 capitalized. These may be taken roughly as grades between 0.5 per cent. and 0.8 per cent.

(3) Those on which brakes are needed in descending and sand used in ascending. These are estimated to cost per daily train per year, per foot of rise and fall, $3.50, which equals $70, capitalized at 5 per cent. These may be taken as any grades over 0.8 per cent., unless of very short length. By multiplying the above sums ($16.80, $33.40, or $70) by the number of daily trains expected, we can arrive at the total expenditure justifiable to save each foot of rise and fall.

TABLE IX.

(*See Wellington, page 544, for larger table.*)

NET TRAIN LOADS OF VARIOUS ENGINES ON VARIOUS GRADES TAKING 25 PER CENT. AS THE RATIO OF ADHESION.

| Grade. | Resistance per ton (in lbs.) | Passenger. | | Mogul and 10-wheel | | | Consolidation. | | | Mastodon. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Wt. | | Total Wt. | | | Total Wt. | | | Total Wt. |
| | | 52 tons. | 58 tons. | 60 tons. | 64 tons. | 67 tons. | 70 tons. | 75 tons. | 80 tons. | 87 tons. |
| | | Weight on drivers. | | Weight on drivers. | | | Weight on drivers. | | | Weight on drivers. |
| | | 20 tons. | 24 tons. | 28 tons. | 32 tons. | 36 tons. | 40 tons. | 44 tons. | 48 tons. | 52 tons. |
| Level | 8 | 1,198 | 1,442 | 1,690 | 1,938 | 2,183 | 2,430 | 2,675 | 2,920 | 3,163 tons |
| $\frac{1}{10}$ per cent. | 10 | 948 | 1,142 | 1,340 | 1,536 | 1,733 | 1,930 | 2,125 | 2,320 | 2,513 " |
| $\frac{2}{10}$ " | 14 | 662 | 799 | 940 | 1,079 | 1,219 | 1,359 | 1,496 | 1,634 | 1,770 " |
| $\frac{5}{10}$ " | 18 | 504 | 609 | 718 | 825 | 933 | 1,041 | 1,147 | 1,253 | 1,357 " |
| 1 " | 28 | 305 | 371 | 440 | 507 | 576 | 644 | 711 | 777 | 842 " |
| $1\frac{1}{2}$ " | 38 | 211 | 258 | 308 | 357 | 407 | 456 | 504 | 552 | 597 " |
| 2 " | 48 | 156 | 192 | 232 | 269 | 308 | 347 | 383 | 420 | 455 " |
| $2\frac{1}{2}$ " | 58 | 120 | 149 | 181 | 212 | 243 | 275 | 304 | 334 | 361 " |
| 3 " | 68 | 95 | 118 | 146 | 171 | 198 | 224 | 249 | 273 | 295 " |
| 4 " | 88 | 62 | 78 | 99 | 118 | 138 | 157 | 175 | 193 | 208 " |
| 5 " | 108 | 41 | 53 | 70 | 84 | 100 | 115 | 129 | 142 | 154 " |
| 10 " | 208 | 0 | 0 | 7 | 13 | 20 | 26 | 31 | 35 | 38 " |

Remember the above sums are not supposed to be precise, but to be as near as it is possible to arrive at the truth. These figures refer to the cost of grades regarded merely as so many feet of rise and fall, and are entirely independent of and distinct from the effect which the maximum grade has on the train load, which is a far more important matter. In special cases, as on the N. Y. C. and H. R. Railway, where the grades are very light, the curves are the limiting features, but usually grades limit and determine the load which a given engine can haul. The hauling capacity usually depends on the weight on the drivers, and the ratio of adhesion, although for high speeds the limits of boiler capacity or cylinder power may be reached first; for freight work, however, the former are all we need to consider. The ratio of adhesion varies from 20 per cent. on slippery rails to 25 per cent. in ordinary weather, and to 33 per cent. where sand is used, but falls at once to about 10 per cent. when the driving wheels begin to slip. For any assumed ratio of adhesion it is easy to compute the load which an engine of known weight on drivers can haul up any grade. The total load includes the engine itself, but on light maximum grades it is not usual to haul maximum loads because of the difficulty in handling long trains and making couplings strong enough to transmit a very heavy pull when combined with the severe jerks caused by the great amount of slack in link and pin couplers. The increasing use of automatic vertical plane couplers having very little slack will soon do away with this difficulty and enable longer trains to be handled with facility. Table IX. enables us to compute the increased or decreased engine mileage due to a change in maximum grades, for any given amount of traffic. For light traffic such calculations must be modified, as more trains will be run to accommodate traffic than are strictly required to carry it, and only as traffic increases so as to afford at least two or three fully-loaded freight trains per day will such calculations be rigidly true—even

then many roads estimate so many cars as a train load irrespective of the load on the car, and the adoption of a tonnage system for making up train loads will, in many cases, effect great economy.

It is noticeable that, on heavy grades, the level tangent resistance forms a very small proportion of the total resistance, and also that, for any given increment of grade, the increase per cent. of engine mileage is much less as the grades become heavier.

Decreased hauling capacity, on heavy grades, may be met in two ways, either by increased weight of engines, especially the weight on the drivers, as is evident from Table IX., or by increasing the number of trains (*i.e.*) the engine mileage.

The former is, of course, the cheaper method, but as the changes in grades that an engineer is called on to discuss are usually relatively small, it is only fair to suppose that the economy of heavy engines will have been realized in both cases; but supposing it possible to increase the weight of engines for heavier grades, only very few of the expenses of operating are increased. Wellington estimates that track maintenance, renewals and engine repairs are increased 50 per cent. as fast as the weight of the engine increases; fuel 25 per cent. and other items practically unaffected. Altogether, the operating expenses will only increase 14 per cent. as fast as the increase in weight of engines.

On the other hand, the usual necessary course on heavier grades will be to run more trains of less tonnage, with the same weight of engine, for a given traffic. This is a more expensive matter.

TABLE X.

INCREASE OF OPERATING EXPENSES WITH INCREASED ENGINE MILEAGE.

| Item. | Cost of Item. | Per cent. increase. | Extra cost |
|---|---|---|---|
| Fuel, oil, and waste | 8.8 % | 67 % | 5.9 % |
| Engine repairs | 5.6 " | 75 " | 4.2 " |
| Switching engines | 5.2 " | 0 " | .0 " |
| Train wages | 15.4 " | 100 " | 15.4 " |
| Car maintenance | 12.0 " | − 10 " | − 1.2 " |
| Track maintenance, etc | 17.5 " | 100 " | 17.5 " |
| Bridges and buildings | 5.5 " | 0 " | 0.0 " |
| Station and general | 30.0 " | 20 " | 6.0 " |
| Interest on extra engines | .... | .. | 1.7 " |
| | 100 % | | 49.5 % |

It will be seen that, say, 50 per cent. of the operating expenses increase with an engine mileage increase, as compared with 14 per cent. in the first case. This is why the weight on drivers is being continually increased, and the strength of the track to carry it, on all roads having much traffic to handle, as being the cheaper expedient.

We are now prepared to estimate the cost of increasing the ruling gradient on an engine division (100 to 125 miles).

Taking a train mile to cost 90 cents, we have $90c. \times 365 \times 2 = \$657$, as the cost of hauling a daily train (both ways) per mile, per year. If we take this *yearly train unit*, multiply it by the number of miles in a given engine division, by the increase in the number of daily trains necessitated by the heavier grades, and then by 50 per cent. (see Table X), we will have the amount which it will probably cost per year more to operate on the heavier grades than the lighter ones. If we capitalize this sum we get the amount which, for a given traffic, it would be wise to expend to construct a road with the lighter ruling grades rather than the heavier ones. (*e.g.*) To avoid changing our ruling grades from 1.0 per cent. to 1.5 per cent. on a hundred mile division, we would be justified in expending anything less than

$$\left(\frac{1000}{504} - \frac{1000}{711}\right) \times \$657 \times 100 \times 50\% \times \frac{100}{5} = \$328{,}500$$

for every 1,000 tons of gross freight per day, taking a seventy five ton consolidation engine as the basis of comparison, and, roughly, two trains per day in one case and one train one day and two trains next day, in the other case, or one-half train per day difference. Now this is a very modest traffic, and yet we could afford to expend $3,285 per mile more in one case than the other, and it is really very much more than it appears, for two reasons:

(1) Because ruling grades in most cases will probably not extend over more than one half of the road as a maximum, and we can therefore spend twice as much per mile on them, or $6,570 per mile as a minimum, on the portions to be improved.

(2) Because all this money can be used below the ballast since track, equipment, stations, etc., in fact, all other items, remain unchanged, now to show how moderate a proportion the cost of substructure is of the cost of the whole road, the following table is given:

TABLE XI.

COST OF FOUR TRACKS OF N.Y.C. AND H.R. RAILWAY PER MILE.

| | | | |
|---|---|---|---|
| Grading and masonry | $22,000 | = 18.9 | per cent. |
| Bridges | 3,030 | " 2.6 | " |
| Superstructure | 32,500 | " 27.9 | " |
| Stations, etc. | 15,400 | " 13.3 | " |
| Land and damages | 15,740 | " 13.6 | " |
| Engines and cars | 24,077 | " 20.7 | " |
| Engineering and incidentals | 3,453 | " 3.0 | " |
| | $116,200 | " 100 | " |

This is an extreme instance, as grading was light and equipment expensive; the items affected (1 and 2) are only 21½ per cent. of the total, and probably 25 to 40 per cent. will give a good average for ordinary single track roads. Each country traversed is suited to certain maximum gradients, and an endeavor to modify them extensively will bring very heavy additional expenses, but within narrow limits, such as a change of ruling grades by as much as $\frac{2}{10}$ or $\frac{3}{10}$ per cent., the advantages of a liberal expenditure of money to obtain the lesser grade are often overlooked and the 'penny wise" maxim adopted. Every engineer who has the decision of the ruling grade should study such figures carefully, and by as extensive surveys as possible determine what is the least ruling grade that he can get at a cost which will be justified by present or expected traffic, always, of course, considering how much money can be got at all, for no expenditure can be justified that will in any way endanger the successful completion of the road; he must consider each item of expenditure or economy, *per se*, whether it is wise or not, remembering always that it is the *difference* of gross receipts, working expenses and fixed charges that is to be thought of in determining the best general route.

Note, however, that these calculations and estimates do not hold strictly true for roads of very light traffic, because some trains must be run in any case to accommodate traffic at certain intervals, and if they are not fully loaded, then an increase of grade will not have any effect until it causes an increase in the number of trains, as a change in the rate of grade does not usually mean any increase in the total rise or fall.

In comparing two routes for costs of operation the best method is to assemble the curves and grades of different classes and take their differences, pro or con, also the difference in the number of trains per day necessary to handle the probable traffic. These differences multiplied by their proper multipliers will give a comparison of how much more valuable one route will be than the other for a given traffic, and will determine consequently how much more can be justifiably spent to construct one route rather

than the other, *other things being equal.* In such a comparison it will be found that any difference in the ruling grades is usually the preponderating item.

(*To be continued.*)

*For* THE CANADIAN ENGINEER.

## NATURAL VENTILATION.

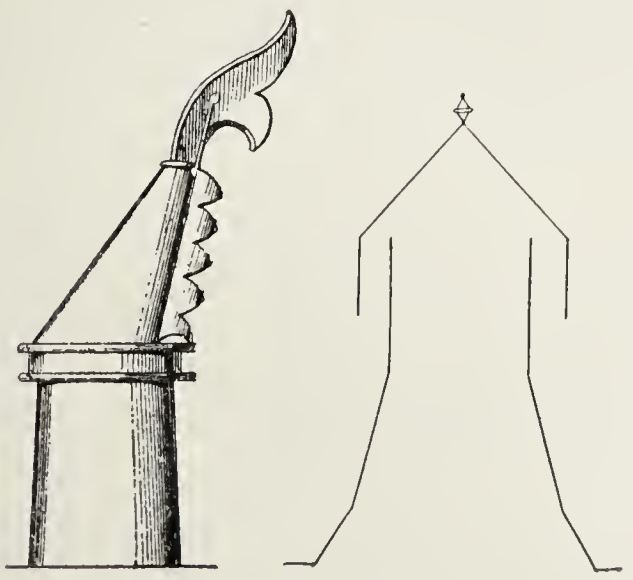
BY W. M. WATSON.

There are several means of thoroughly purifying and ventilating buildings by mechanical appliances. There is also a good method of forcing ventilation by the semi-natural process of passing the raw atmospheric air over hot steam or water pipes, which largely increases the temperature of the fresh air, causing it to expand and become lighter, and so ascending through tubes to any required room. This is only useful in cold weather, and where adopted there must be other means provided to ventilate in warm and temperate seasons. The same result is got by using a hot-air furnace in place of the steam or hot water heater, but the air after passing over the hot plates is dry, and soon injures the respiratory organs.

These methods are more or less costly; they often take up considerable room, and require attention to work them properly. Therefore it is necessary to provide natural means of purifying the interior of rooms that will be almost self acting in all weathers, that will be permanent in fixture, work mildly without creating any perceptible chilling draught; also that can be erected without curtailing any floor space, and that can be arranged at a very moderate cost, so that every dwelling, however cheaply built, can have its advantages. Such a method of purifying the air is called natural ventilation.

It has been proved that an average adult discharges $\frac{6}{10}$ of a cubic foot per hour of carbonic acid gas by respiration, together with some impurities from the skin by transpiration, and that to have a healthy atmosphere each person should have 600 cubic feet of air space, and the air of the room should be totally changed twice during the first, and three times during every other hour the person remains in the room. Common gas burners consuming 4 c. ft. per hour produce about 8 c. ft. of carbonic acid gas, which requires about 5,000 c. ft. of fresh air per hour to properly dilute it, unless some special provision is made to carry it away without allowing it to mix with the air of the room. The fumes from the light of gas made from water, and afterwards enriched by introducing kerosene oil, should never be allowed to mix with air that is to be breathed.

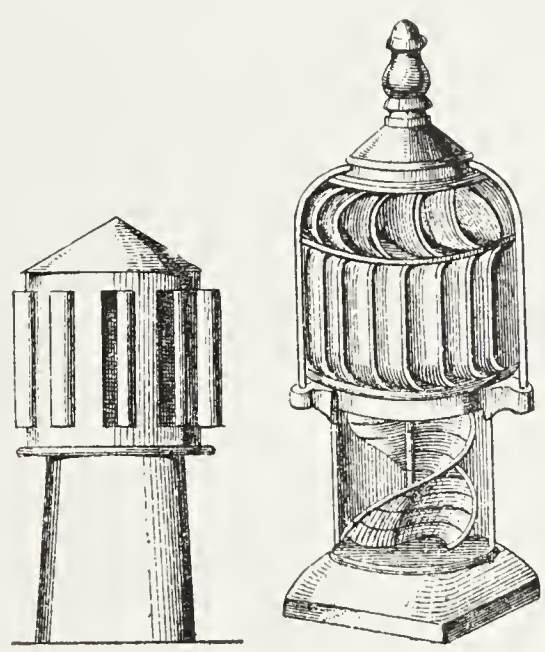
On account of the heat of the climate having a variation of about 100 degrees, it is somewhat difficult to provide natural ventilation that will answer at all seasons of the year, because it is out of the question to ventilate an apartment by bringing in air at the freezing point without first warming it; and it is equally necessary to cool the hot summer atmosphere before using it for purifying purposes.



FIGS. 1 AND 2.

During the hot season a large hole in the roof shielded from the rain, with doors and windows open, seems acceptable, or a single flued ventilator having only an up-draught which requires an air duct from the outside to bring in the air necessary to form the current, or having some window or door open to cause the air of the room to move and pass up through the tube, similar to Figures 1, 2 and 3.

Howorth invented a ventilator that drew the air from the room by a powerful screw, but it could not draw more out than was let in. It had an advantage over the plain tube ones, because it considerably increased the speed of the current, and an 18-inch Howorth's would do as much work as a 24-inch plain one. They are made so well and accurately, having a neat provision for oiling and keeping the pivot and foot-block clean, that they will run about 100 revolutions per minute for about five years in a light wind without attention. (See Fig. 4.)



FIGS. 3 AND 4.

Any kind of one-flued ventilator will answer to pass out the tainted air of dwellings that are heated by hot air, because the atmospheric air is brought into the basement to be heated, and must necessarily travel upward and out at the highest point after performing its duty. By making a by-pass from the cold air duct and the hot air flues the same ducts and air channels could be used to ventilate when no heat was needed.

In most cases, especially for private houses, natural ventilation, together with making use of such powers of extraction as can be got by utilizing the sources of warming and lighting, is sufficient, if we so arrange things that the air can take its proper share in the constant changes Several scientists have made experiments, and all agree that where no artificial means are used to move and guide the currents of air intended to purify the interior of rooms without opening doors or windows, the outside atmosphere should enter the room at the ceiling at the point where the atmosphere of the room possesses the most heat. It will, on entering, fall through the heated air (because it is heavier and denser than the hot, tainted air that is rising to pass out), down to the floor level, and during its passage will extract and absorb some of the heat from the foul air, which will take off the chill and make the fresh air pleasant to inhale by the time it gets low enough to be used by the inmates.

I am told that the ancient system can yet be seen in

many places in Egypt of ventilating by a bent tube facing the wind, similar to the ones used on steamships, being placed on the roof, the air being pressed down into the interior by the pressure of wind, which is one pound to the foot when travelling at the rate of three and a half miles per hour, but when this method is adopted on permanent buildings it is a failure, because when ventilation is most necessary there is no wind with power enough to create a current.

TABLE *to show the Discharge of Air in linear feet per minute. Calculated from Montgolfier's formula; the expansion of air being taken as 0·002 for each degree Farenheit, and one-fourth being deducted for friction. (Round numbers have been taken.)*

| Height of column. | Difference between Internal and External Temperature. | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 30 |
| 10 | 88 | 102 | 114 | 125 | 135 | 144 | 153 | 161 | 169 | 176 | 183 | 190 | 197 | 204 | 210 | 216 | 222 | 228 | 233 | 239 | 244 | 249 | 254 | 279 |
| 11 | 92 | 107 | 119 | 131 | 141 | 151 | 160 | 169 | 177 | 185 | 192 | 200 | 207 | 213 | 220 | 226 | 233 | 239 | 245 | 250 | 256 | 261 | 267 | 292 |
| 12 | 96 | 111 | 125 | 136 | 147 | 158 | 167 | 176 | 185 | 193 | 201 | 209 | 216 | 223 | 230 | 237 | 243 | 249 | 255 | 261 | 267 | 273 | 279 | 305 |
| 13 | 100 | 116 | 130 | 140 | 153 | 164 | 174 | 183 | 192 | 201 | 209 | 217 | 225 | 232 | 239 | 246 | 253 | 259 | 266 | 272 | 278 | 284 | 290 | 318 |
| 14 | 104 | 120 | 135 | 147 | 159 | 170 | 181 | 190 | 200 | 209 | 217 | 225 | 233 | 241 | 248 | 255 | 262 | 269 | 276 | 282 | 289 | 295 | 301 | 330 |
| 15 | 108 | 125 | 139 | 153 | 165 | 176 | 187 | 197 | 207 | 216 | 225 | 233 | 241 | 249 | 257 | 264 | 272 | 279 | 286 | 292 | 299 | 305 | 312 | 341 |
| 16 | 111 | 129 | 144 | 158 | 170 | 182 | 193 | 204 | 213 | 223 | 232 | 241 | 249 | 257 | 265 | 273 | 281 | 288 | 295 | 302 | 309 | 315 | 322 | 353 |
| 17 | 115 | 133 | 148 | 162 | 176 | 188 | 199 | 210 | 220 | 230 | 239 | 248 | 257 | 265 | 274 | 282 | 289 | 297 | 304 | 311 | 318 | 325 | 332 | 363 |
| 18 | 118 | 136 | 153 | 167 | 181 | 193 | 205 | 216 | 226 | 237 | 246 | 255 | 264 | 273 | 282 | 290 | 298 | 305 | 313 | 320 | 327 | 335 | 342 | 374 |
| 19 | 121 | 140 | 157 | 172 | 186 | 198 | 210 | 222 | 233 | 243 | 253 | 262 | 272 | 281 | 289 | 298 | 306 | 314 | 321 | 329 | 336 | 344 | 351 | 384 |
| 20 | 125 | 144 | 161 | 176 | 190 | 204 | 216 | 228 | 239 | 249 | 259 | 269 | 279 | 288 | 297 | 305 | 314 | 322 | 330 | 338 | 345 | 353 | 360 | 394 |
| 21 | 128 | 147 | 165 | 181 | 195 | 209 | 221 | 233 | 245 | 255 | 266 | 276 | 286 | 295 | 304 | 313 | 321 | 330 | 338 | 346 | 354 | 361 | 369 | 404 |
| 22 | 131 | 151 | 169 | 185 | 200 | 214 | 226 | 239 | 250 | 261 | 272 | 282 | 292 | 302 | 311 | 320 | 329 | 338 | 346 | 354 | 362 | 370 | 378 | 414 |
| 23 | 134 | 154 | 173 | 189 | 204 | 218 | 232 | 244 | 256 | 267 | 278 | 289 | 299 | 309 | 318 | 327 | 336 | 345 | 354 | 362 | 370 | 378 | 386 | 423 |
| 24 | 136 | 158 | 176 | 193 | 209 | 223 | 237 | 249 | 261 | 273 | 284 | 295 | 305 | 315 | 325 | 335 | 344 | 353 | 361 | 370 | 378 | 386 | 394 | 432 |
| 25 | 139 | 161 | 180 | 197 | 213 | 227 | 241 | 254 | 267 | 279 | 290 | 301 | 312 | 322 | 332 | 342 | 351 | 360 | 369 | 378 | 386 | 394 | 402 | 441 |
| 26 | 142 | 164 | 183 | 201 | 217 | 232 | 246 | 259 | 272 | 284 | 296 | 307 | 318 | 328 | 338 | 348 | 358 | 367 | 376 | 385 | 394 | 402 | 410 | 450 |
| 27 | 145 | 167 | 187 | 205 | 221 | 237 | 251 | 264 | 277 | 290 | 302 | 313 | 324 | 335 | 345 | 355 | 365 | 374 | 383 | 392 | 401 | 410 | 418 | 458 |
| 28 | 147 | 170 | 190 | 207 | 225 | 241 | 255 | 269 | 282 | 295 | 307 | 319 | 330 | 341 | 351 | 361 | 371 | 381 | 390 | 399 | 408 | 417 | 426 | 467 |
| 29 | 150 | 173 | 194 | 212 | 229 | 245 | 260 | 274 | 287 | 300 | 312 | 324 | 335 | 347 | 357 | 368 | 378 | 388 | 397 | 407 | 416 | 425 | 433 | 475 |
| 30 | 153 | 176 | 197 | 216 | 233 | 249 | 264 | 279 | 292 | 305 | 318 | 330 | 341 | 353 | 363 | 374 | 384 | 394 | 404 | 414 | 423 | 432 | 441 | 483 |
| 31 | 155 | 179 | 200 | 219 | 237 | 253 | 269 | 283 | 297 | 310 | 323 | 335 | 347 | 358 | 369 | 380 | 391 | 401 | 411 | 420 | 430 | 439 | 448 | 491 |
| 32 | 158 | 182 | 204 | 223 | 241 | 257 | 273 | 288 | 302 | 315 | 328 | 341 | 353 | 364 | 375 | 386 | 397 | 407 | 417 | 427 | 437 | 446 | 455 | 499 |
| 33 | 160 | 185 | 207 | 226 | 245 | 261 | 277 | 292 | 307 | 320 | 333 | 346 | 358 | 370 | 381 | 392 | 403 | 414 | 424 | 434 | 443 | 453 | 462 | 506 |
| 34 | 162 | 188 | 210 | 230 | 248 | 265 | 282 | 297 | 311 | 325 | 338 | 351 | 363 | 375 | 387 | 398 | 409 | 420 | 430 | 440 | 450 | 460 | 469 | 514 |
| 35 | 165 | 190 | 213 | 233 | 252 | 269 | 286 | 301 | 316 | 330 | 343 | 356 | 369 | 381 | 393 | 404 | 415 | 426 | 436 | 447 | 457 | 467 | 476 | 522 |
| 36 | 167 | 193 | 216 | 236 | 255 | 273 | 290 | 305 | 320 | 334 | 348 | 361 | 374 | 386 | 398 | 410 | 421 | 432 | 442 | 453 | 463 | 473 | 483 | 529 |
| 37 | 170 | 196 | 219 | 240 | 259 | 277 | 294 | 310 | 325 | 339 | 353 | 366 | 379 | 392 | 404 | 415 | 427 | 438 | 448 | 459 | 470 | 480 | 490 | 536 |
| 38 | 172 | 198 | 222 | 243 | 262 | 281 | 298 | 314 | 329 | 344 | 358 | 371 | 384 | 397 | 409 | 421 | 432 | 444 | 454 | 465 | 476 | 486 | 496 | 543 |
| 39 | 174 | 201 | 225 | 246 | 266 | 284 | 302 | 318 | 333 | 348 | 362 | 376 | 389 | 402 | 414 | 426 | 438 | 450 | 461 | 471 | 482 | 492 | 503 | 551 |
| 40 | 176 | 204 | 228 | 249 | 269 | 288 | 305 | 322 | 338 | 353 | 367 | 381 | 394 | 407 | 420 | 432 | 444 | 455 | 467 | 477 | 488 | 499 | 509 | 558 |
| 45 | 187 | 216 | 241 | 264 | 286 | 305 | 324 | 341 | 358 | 374 | 389 | 404 | 418 | 432 | 445 | 458 | 471 | 483 | 495 | 506 | 518 | 529 | 540 | 591 |
| 50 | 197 | 228 | 254 | 279 | 301 | 322 | 341 | 360 | 377 | 394 | 401 | 426 | 441 | 455 | 469 | 483 | 496 | 509 | 522 | 534 | 546 | 558 | 569 | 623 |
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 30 |

To use the table, determine the height of the warm column of air from the point of entrance to the point of discharge. Ascertain the difference between its temperature and that of the external air. Take out number from table, and multiply by the section area of the discharge-tube or opening, in foot or decimals of a foot. The result is the discharge in cubic feet per minute, multiply by 60—result, discharge per hour. *Example*—Height of column, 32 feet; difference of temperature between internal and external air, 17 deg. Looking in the table, we find opposite to 32 and under 17,375 feet. That would be for an area of 1 square foot.

But supposing our air opening to be only ¾ of a foot, we must multiply 375 by ¾ or 0·75 of a foot.

$$\begin{array}{r} 375 \\ \cdot 75 \\ \hline 1875 \\ 2625 \\ \hline 281\cdot25 \end{array}$$

Therefore we get 281 feet (per minute), multiplied by 60 = 16,860 feet per hour.

With a view to prevent wind acting upon the currents all air ducts should be bent, having two or more elbows, and the mouth should either face up or downward. To avoid the chilling sensation of drafts when ventilation is secured by air ducts, the inlet should be sufficiently large to allow the necessary quantity to enter the room slowly, say about the rate of one mile per hour, and the inlet should be larger than the outlet. It is the size of the outlet that regulates the quantity of air entering and passing out of a room. Therefore it is necessary to know the size of tube or valve required to pass the proper quantity of air. Montgolfier's formula gives a valuable table showing the size needed under many variations between the temperature outside and inside, and also the height of the rooms, which will answer if the inlet end of the air duct is well shielded against the pressure of wind.

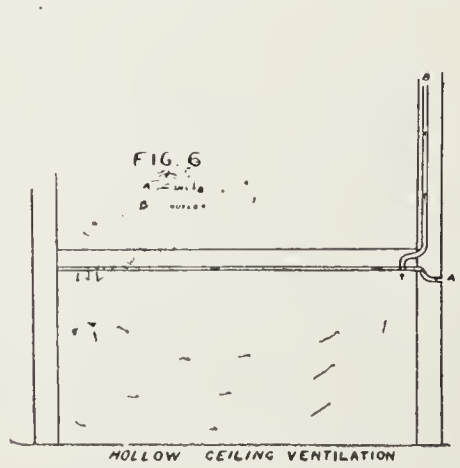
It is not necessary to make channels large enough to pass all the air needed, except the house be as tight as a glass show case, because there are generally streams of air passing in and out of the chinks of windows and doors, and even walls and plaster, except they happen to be painted and papered. Marcker proved by experiments that the following amount of air passes in one hour through a square meter of wall when the difference in the temperature was only 1° C., viz.: Sandstone, 1.69; limestone, 2.32; good brick, 2.83; loamy brick, 5.12, and that it increased in the ratio of the increase in the difference of the temperature between the outside and the interior.

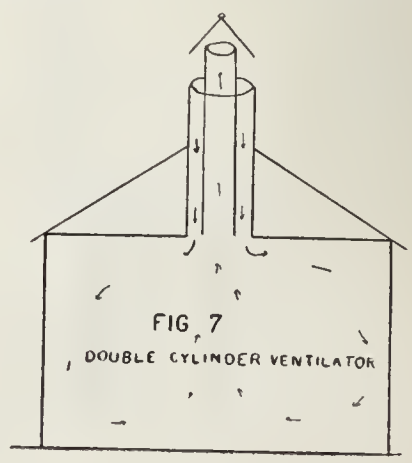
No doubt the best way to venti'ate is by bringing in the fresh air at or near the ceiling at one end of the room, and extracting the tainted air at or near the floor line at the opposite end of the room, but this can only be done when an exhaust fan is used or there is a long chimney at least three times the height of the room. And even when a chimney is used, some method should be made to create some artificial heat at the bottom, to increase the draught at times when the temperature is nearly equal inside and out, because of the resistance to be overcome in drawing down the warm air in the room.

Dwellings can be simply and well ventilated by leaving all the interior partition walls two inches short of the ceilings, so that the air of every room can freely pass slowly out in long thin volumes into the entrance hall and staircase well. Then fix one double draught ventilator with a 24 to 30-inch body over the well on the roof. This will keep the air fresh and pure.

When a house is in course of erection a proper system of ventilation can be made for each room separately by building the outside walls hollow, having a 4-inch space carefully plastered smooth on both sides inside. This space would greatly benefit the house by keeping it warmer in winter and cooler in summer, but the space would also answer for an air duct leading to every room which would convey the necessary amount of air in slowly and cool the current a little in summer and warm it in winter. To draw off the tainted air of each room the main chimney should be so built as to be handy for inserting every tube drawing the foul air from the rooms, also handy to receive the smoke pipes serving all the needed fires. There should be a wrought iron tube inside the chimney, with branches to receive the smoke. Round the smoke-tube there should be about 6 inches of space to act as an air flue, and into that air space all air ducts should be carried. The chimney should have a couple of slow-turned elbows near the top in order to prevent the pressure of the outside atmosphere bearing its weight down the full length of the chimney, injuring the chimney efficiency. A straight vertical chimney or air flue is of little use for creating a draught, except it is carried to a great height, besides having plenty of heat or a forced draught at the bottom.

The space between joists could be made useful for bringing in and tempering the incoming current in winter, or better still, if the ceilings could be made with two plates having a half-inch space between, coupled at one end of the room with the outside atmosphere, by a long bent flue, and pierced with holes at the other end of the room to allow the fresh air to enter. The fresh air while travelling between the two ceiling plates across the top of



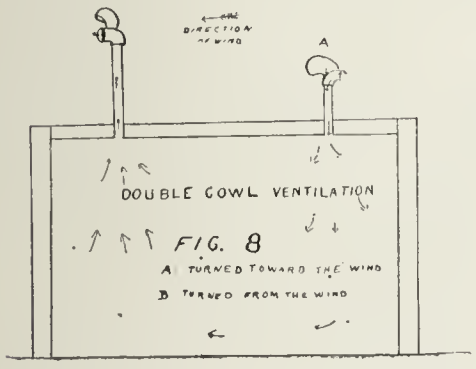
the warm room would increase in temperature so much that very little heat would be lost by changing the atmosphere of the room twice an hour (see fig. 6). By this method the extractor would have to be so arranged that it would have a keen draught.

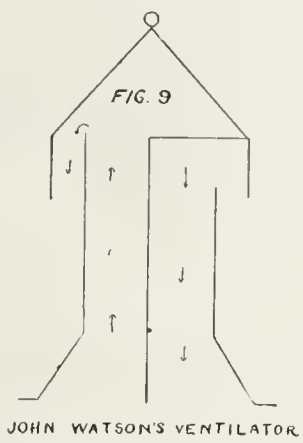
Potts describes a similar system of ventilation to this by having a hollow cornice round the room, with a double row of holes, one row connected to the outside air and the other row connected with a heated flue of a chimney, and the system worked well.

Seventy years ago Sylvester used a hot air furnace of a far superior type, and more economical with fuel than any of those made at the present day to force ventilation and warm houses. His stove had plenty of wing plates that increased the radiating power. He placed a large pipe finishing with a cowl a little distance from the building, where it could face the wind in which ever direction it happened to blow, at a height of about six feet from the ground. The wind entering the cowl continued on through an underground channel to the basement of the house, where it entered a chamber containing a stove which heated the air and conveyed it through pipes to each room.

McKennell ventilated by placing two cylinders in the ceiling, one inside the other, the inner one terminating about 6 inches higher than the outside one. The space between the two tubes was equal to the area of the inside cylinder. By this method he caused an in and out draft by one machine. (See Fig. 7).

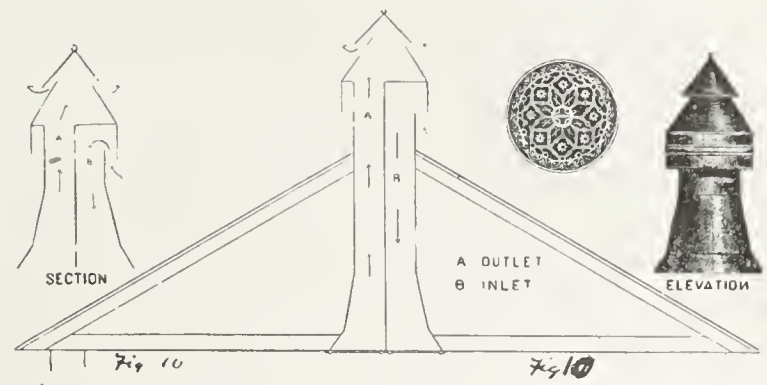
Arnott took advantage of the unequal density of the masses of air at different elevations. He ventilated by placing two moving cowls on the roof, one arranged to face the wind and the other to face the way it was blowing. The one that faced the wind was set several feet lower than the other and formed the inlet; the high one that faced the way the wind was going made a good ex-




tractor. The machine was valuable for large meeting rooms. (See Fig. 8).

The late John Watson crystallized some ideas and built a double current ventilator having a compact and graceful form. It had a perfectly air tight division vertically through the centre, the half moon shaped tube on one side terminating about 6 inches higher than the other side. (See Fig. 9.) This little difference in the height of the half tubes caused an inlet and outlet action. These ventilators are at present purifying the air of many of the English public buildings. The first time I fixed this class of ventilator I considered Mr. Watson did not get all the work out of his design that he might, and I afterwards designed one that gave a space of 30 inches between the inlet and outlet, by so doing increasing its extracting power. (See Fig. 10). I made a small one with an 8-inch body to test with, and fixed it on an air-tight glass show case containing 8 cubic feet of air space. Inside at the bottom of the case were placed four lighted gas burners, burning 5 feet per hour each. I fixed wires with feathers attached all over inside the case to indicate the way the air moved. The case was outside for a week during one of the coldest spells in winter. The test proved that the air dropped to the floor level, penetrating every corner of the case; then,




after making a circular tour, it again passed to the outside up through the other half of the ventilator. The whole of the glass of the case and the down draught half of the ventilator kept cool all the time, while the upcast side was hot. And if passage of air stopped the lights would at once die out.

None of the systems of ventilating that I have here described are covered by patents, and if the reader fancies any of them he can use the ideas freely, and I hope improve them, and then give publicity to his ideas.

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*For* THE CANADIAN ENGINEER.

## THE OTTAWA VALLEY CANAL.

BY ANDREW BELL, C E

When referring to the scheme—now exciting so much interest—to construct a deep-water canal via the Ottawa River to Georgian Bay, it is now well recognized that the most difficult engineering problem to be solved is how to get deep water on what is generally called the Lower Ottawa—say between Lachine and Arnprior. That part of the river flows over flat limestone rock, consequently the still water reaches are wide and shallow—the shallowest parts often extending some distance up and down stream—and this difficulty seems to be greatest towards the lower end, namely, from a short distance above Lachine to above St. Ann's—due, but only partly, to the river dividing above the latter place, and the larger part going north of the Island of Montreal. At present not more than 8 feet depth for navigation can be depended upon between Lachine and Ottawa city in low water.

The rapids between Lachine and Arnprior are St. Ann's, 3 ft. fall; Carillon, 16 ft.; Long Sault, 44 ft.; Chaudiere and Des Chenes, 60 ft. (about); and Chatts, 40 ft.

Deep water can be made by raising the surface, or by lowering the bottom, or by both.

As the banks of the lower river are generally low and thickly settled, raising the surface permanently, even a few feet, seems to me to be totally out of the question. The dams would be extremely expensive to construct and expensive to keep in repair; the raising of the water would be resisted to such an extent as to almost cause a rebellion, besides destroying the appearance and value of a large area of country. Where it is possible to widen the channel for high water by excavating the banks above low water marks, low dams could be put in at head of rapids to such an extent as can be compensated for by that widening for high water; thus raising low water but keeping down high water to its original height. Two or three feet might be gained in that way for low water, and the low dams would enable the water to be "laid hold of" for power purposes.

To get the required depth, over the part of river referred to, lowering the bottom where necessary must be generally resorted to in some manner. Where the shal-

lows are earth they can be dredged ; where they are rock, as is generally the case, if short they can be sub-marined; if long, resort must be had to excavation inland, or along shore, where the expense of un-watering is the least.

The question cannot be settled until more and better information is obtained, based on the changed conditions of the present proposals. All the surveys heretofore made for canalling the Ottawa only looked for 10 or 12 feet deep. I made extensive surveys in 1870-82 from above Grenville to below Carillon, and also (by an assistant), above and below St. Anns, but my instructions only required me to look for 10 feet depth. The public would not be satisfied in the new scheme with less than 20 feet. Careful and exhaustive surveys must be made and from them the best solution of the problem studied out, when it is to be hoped the difficulties will, to a great extent, disappear.

It may be found best to take the canal by way of the Back River from Lake of Two Mountains, instead of by Lachine and Montreal. The rapids can be overcome as is done at present below Ottawa, by excavating channels along shore, either a little inland or by " fencing in " part of the bed of river at the shore.

There is considerable difference between high and low water in the Lower Ottawa. This varies at different places, being least at Carillon, where it averages about 10 feet. By making deep water on the middle parts of the canals around rapids, that is, the parts where the surface is not effected by the rise and fall of the river, there would at present be 20 feet navigation in high water, and 12 to 15 feet for a considerable part of the season. Unfortunately, as the navigation is most required at the time of the year when the water is lowest, not much would be gained by utilizing high and medium water in that way, but it might be adopted to some extent while work at deepening the slack water stretches was in progress, which will necessarily be slow.

Above Arnprior the river flows through laurentian rocks. The banks are generally high and as yet thinly populated. The slack water reaches are almost always deep, and shallows, where they occur, are mostly short. The channels at rapids are narrow, and all conditions for damming good ; so that where deeper water than exists is wanted it can be obtained by raising the surface where that is found to be cheaper than excavating.

The amount of water power which can be developed is an interesting subject, but is little known. From a series of measurements I took at Carillon, between 1872 and 1882, with rather imperfect appliances, I made out the flow of the river there to be in very high water 200,000 cubic feet per second, and in extreme low water, 25,000 cubic feet per second, ordinary low water being about 30,000 to 35,000 cubic feet per second. When the Ottawa canal is made the dams which must be built on the Upper Ottawa will of course regulate the flow by retaining a portion of the spring floods for use during low water. It is safe to say that this will be done to such an extent that at least 42,000 cubic feet per second can be depended upon as the lowest at any time of the year between St. Ann's and Mattawa. That would give, taking 20 per cent. off for loss in application, 4,000 horse power per foot fall. The tributaries emptying into the river between the points mentioned should give about a quarter more in the vicinity of the Ottawa before they fall into it. That would make on the Ottawa, from Mattawa downward and its branches, close to main stream, about 2,500,000 horse power to be depended on all the year round—not including the extra power which might be developed for three months or more during high water.

## ONTARIO AND ALASKA.

We Canadians are so used to the idea of our vast territories and their boundless wealth that we feel deep annoyance at times to find that some foreigner, or even traveller from the motherland, is not familiar with our riches. Now we find ourselves with new discoveries every day, and look back on our former knowledge of our country's greatness in much the same way as we look on the foreigner's total ignorance of it. The lands which some of us thought to be producing a good crop when we read over the report of the Hudson's Bay fur sales, are now known to be as valuable as any in all our wide Dominion.

There are two great obstacles to the development of our northern regions, the rigor of the climate, and the enormous distances to be traversed. If facilities could be provided for rapidly handling the freight and passenger traffic of these regions during the warm season, the extreme cold of the winter months would not be so serious a handicap. At present all eyes are turned toward the Klondyke, and there is, therefore, the more interest in considering the prospectus of the Sault Ste. Marie and Hudson's Bay Railway Co., which proposes not only to reach the Klondyke, but to open up the million and a-quarter square miles of lands which lie in the basin of the Mackenzie river, which abound, as we know they do, in timber and fish, and contain coal and petroleum areas unapproached elsewhere upon the globe.

The resources of this country were examined into by a select committee of the Senate of the Dominion of Canada, and a report published by authority of Parliament in 1888. The committee was appointed to enquire into the resources of that part of the Dominion lying north of the Saskatchewan watershed, east of the Rocky Mountains, and west of Hudson's Bay, and comprising the Great Mackenzie Basin—its extent of navigable rivers, lakes and sea coast, of arable and pastoral land, its fisheries, forests and mines, and to report upon its possible commercial and agricultural value. The committee reported that the Mackenzie Basin comprised an area estimated at 1,260,000 square miles ; also that the three great lakes, Athabasca, Great Slave Lake, and Great Bear Lake, have navigable coast lines of over 4,000 miles, with an area probably exceeding that of the great lakes of the St. Lawrence Basin, excluding Lake Michigan. That there are 2,750 miles of navigable water in the Mackenzie River and main tributaries, of which 1,360 miles are north of the rapids of the Great Slave River, and can be navigated by ocean steamers of medium draught.

The eastern extremity of Great Slave Lake is only a short distance from the navigable waters of Hudson's Bay. The report stated that within the Mackenzie River there is a possible area of 656,000 square miles fitted for the growth of potatoes, 407,000 square miles suitable for barley, and 316,000 square miles suitable for wheat. That there is a pastoral area of 860,000 square miles, 26,000 miles of which is open prairie with occasional groves, the remainder being more or less wooded; 274,000 square miles, including the prairie, may be considered as arable land. That about 400,000 square miles of the total area is useless for the pasturage of domestic animals or for cultivation. This area comprising the Barren Grounds and a portion of the lightly wooded region to their south

and west. That throughout this arable and pastoral area latitude bears no direct relation to summer isotherms, the spring flowers and the buds of deciduous trees appearing as early north of Great Slave Lake as at Winnipeg, St. Paul and Minneapolis, Kingston, or Ottawa, and earlier along the Peace, Laird, and some minor western affluents of the Great Mackenzie River, where the climate resembles that of western Ontario. That the native grasses and vetches are equal and in some districts superior to those of eastern Canada. That the prevailing south-west summer winds of the country in question bring the warmth and moisture which render possible the far northern cereal growth, and sensibly affect the climate of the region under consideration as far north as the Arctic circle and as far east as the eastern rim of the Mackenzie Basin.

Fish were found in abundance and salmon in nearly all the rivers.

The forest area, the report says, has upon it a growth of trees well suited for all purposes of house and ship-building, for mining, railway and bridging purposes, far in excess of its own needs, and of great prospective value to the treeless regions of Canada and the United States to the south, the growth on the Laurentian formation being scant, but the alluvial portion has upon it the "Liard," a balsam poplar, sometimes called Balm of Gilead or rough bark poplar, 120 feet high, with a stump diameter of five or six feet. The *white spruce*, 150 feet high, with a stump diameter of four to five feet; the *larch* of about the same size, and the *banksian pine*, whose straight stem is often 100 feet long, with only two feet of diameter at the stump.

This is the country to which we wish to secure ready access. The route proposed is shown by the accompanying map. From Missanabie on the C.P.R., to Moose Factory on James' Bay, the southern extremity of Hudson's Bay, is 250 miles; from Moose Factory to the head of Chesterfield Inlet, the north-western extremity of Hudson's Bay, is 1,300 miles of deep water navigation; from the head of Chesterfield Inlet to Great Slave Lake is not more than 175 miles, where a portage railway would be built; from Great Slave Lake to the mouth of the Mackenzie River is 1,400 miles; a railway line 50 miles long would connect the mouth of the Mackenzie river with the Porcupine, a branch of the Yukon, which affords navigable water for 1,500 miles to the Behring Sea.

The line from Missanabie to Moose Factory is estimated to cost $30,000 per mile, or $7,500,000, and this sum it is proposed to raise partly by means of land and money grants which are to be asked from the Ontario and Dominion Governments on the following conditions: First—That no payments should be made until a considerable part of the work was actually done, and that a large reserve should be made until the road was actually finished to Hudson Bay. Second—That the stock control of the enterprise should be deposited in Toronto as a trust, and that it should be retained in that condition until the railway was completed and open for traffic. Then that the Dominion Government, and after that the Provincial Government, and following these the citizens of Canada and of Toronto, should have an opportunity of taking a controlling interest in the stock at par, which should be valued in the construction operations at the same rate.

MAP SHOWING THE NEW OR "HARVEY ROUTE"

*Between the north-western boundary of Canada and the northern seaport of Ontario via navigable waterways in the basins of the Mackenzie and Yukon Rivers with "portage" railways crossing the "divides" between the same, and connecting with Hudson's Bay*

ENGLISH MILES

SEE NOTE

Of the charter under which the first line in this new chain of connection is to be built was granted to a number of Sault Ste. Marie men seven years ago, and was transferred by them a short time since to a group of well-known Toronto capitalists, among whom are Stapleton Caldecott, S. H. Blake, J. W. Langmuir, Robt. Kilgour, and James Scott.

The engineer in charge of the preparatory work is Charles T. Harvey, C.E., whose work is well known in connection with a number of important works.

## THE DEEP WATERWAYS QUESTION.

The United States commission appointed to consider the question of an international deep waterway route from the Great Lakes to the sea has reported to Congress, and the Canadian commission appointed to co-operate with the American commission have also sent in their report. The

American commissioners' report was promptly published and sent to the Canadian Government, but the Canadian report, though rendered last June before Parliament prorogued, has not yet seen the light. This is much to be regretted, because apart from the fact that the Canadian public should be in a position to study this question, it is demanded by international courtesy that the American Government and public should have the same prompt access to the information gathered by the Canadian commissioners as they have given us of theirs. To delay the Canadian report would appear all the more strange, seeing that the Minister of Railways and Canals has himself reprinted the American commissioners' report in his own departmental blue book.

Following up their commissioners' report, the United States Congress has appropriated a further sum of $150,000 for new surveys bearing on the contemplated international deep water channel to the seaboard. These new surveys will be in charge of a commission more exclusively composed of engineers, the commercial aspect of the case having already been fully gone into in the last report. It is thought that the Canadian Government will co-operate in these new surveys, and then the question of the cost of the deepening and the further question of control and regulation of the proposed great water route will be considered. It is to be hoped that our Government will not lose any more valuable time in dealing with a subject of such great importance to the marine interests of Canada.

Meantime, it may be observed that a commission of military engineers appointed by the U.S. Government have enquired into the question as to how the levels of the Upper Lakes will be affected by the Chicago drainage canal, and have condemned the scheme as likely to have a serious effect on the navigation of the Great Lakes. If it is found that the City of Chicago, by creating a large river here—f r that is what the new canal means—causes the lowering of the lake levels, the Government will step in and compel the city to reduce the flow of water to the limits of safety. Happily for Canada, there are more populous cities on the American shores of the Great Lakes that would be damaged or ruined by the Chicago canal than on the Canadian shores, and the international riparian rights, as well as the local commercial interests all along the lakes and rivers, combine to make an influence that will outweigh the selfish interests of even a Chicago. So we may hope that the American Government will not allow Chicago to lower the lakes by a single inch; for the deepening of the canals from the Great Lakes to the ocean will be as important for that emporium as for the other cities and towns scattered along the shores of these vast fresh water seas.

Last month the American Government received a report from Major T. W. Symons, of the U. S. Corps of Engineers, a preliminary report on the question of a ship canal to the sea exclusively through United States territory. A synopsis of the report will be found in another column.

## THE VICTORIA JUBILEE BRIDGE AT MONTREAL.

When the present Victoria Tubular Bridge across the River St. Lawrence at Montreal was built, it created at the time universal admiration for its noble proportions and the skill displayed by its engineers, as well as amazement at its gigantic size and stability—in fact it was looked upon as one of the wonders of the world. Built between 1854 and 1859, and with little or no precedent for many important details connected with the structure, one is bound, even at this day, to acknowledge the wisdom and foresight of the engineers and contractors who planned and built it. Far-sighted, however, as the promoters of this bridge were, in regard to details of construction, the most sanguine of them, in all probability, never realized that within thirty years from its opening the demands upon its capacity would be so great as to make a larger structure a necessity. This need has been specially felt in recent years, as the traffic of the Grand Trunk Railway developed and increased so enormously, and, as far as the bridge itself is concerned, will the more easily be understood when it is considered that over eighty trains pass through the bridge during the twenty-four hours. It is well known that the passage of trains through the bridge has always been conducted on the absolute block system, and no train received orders to proceed through until the preceding one had reported to the telegraph station at either end.

This famous bridge will soon only be a matter of history, for it is about to be replaced by one modern in design, built in accordance with the best practice of the present day, and of accommodation sufficient probably to meet all future requirements. The superstructure of the bridge which is to replace the present tubes, will consist of twenty-four spans of pin-connected, through, steel trusses, each of a length of 254 feet between centres of end pins, and one span of 348 feet over the steamboat channel. The trusses will carry two railway tracks to be used by ordinary steam railway trains, as well as by electric railways, and the floor beam system will be extended beyond the trusses of sufficient length for an ordinary vehicle roadway and sidewalk on either side. The clear width between the trusses will be 28 feet. For each railway track there will be four lines of stringers, spaced two feet five and a half inches from centre to centre. There will also be two lines of stringers for each roadway, and one line placed at the ends of the projecting beams for the support of the outer edge of the sidewalk. The clear headway from the base of track rails to the struts under the overhead lateral bracing will be 22 feet.

The trusses have been proportioned to carry the undermentioned loads:—

First.—The total weight of metal in them.

Second.—The weight of the wooden floor beams, planking, sidewalks, guard timbers, railings, rails and fastenings, etc., amounting in the aggregate to 2,800 lbs. per lineal foot.

Third.—A moving load in either direction on each side of the two tracks, of two consolidation engines and tenders, coupled, followed by a uniformly distributed load weighing 4,000 lbs. per lineal foot, or 100,000 lbs. equally distributed on two pairs of driving wheels spaced $7\frac{1}{2}$ feet centre to centre.

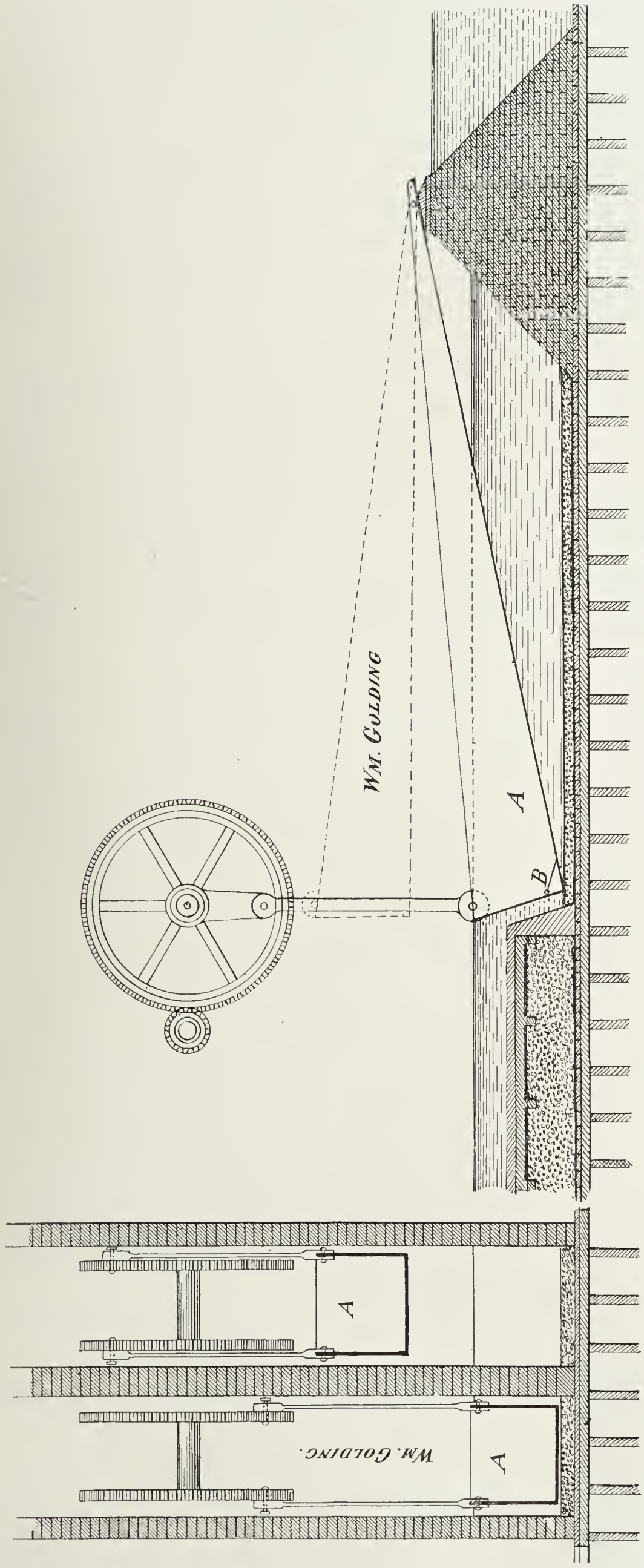
Fourth.—A moving load in either direction on each of the roadways of 1,100 lbs. per lineal foot.

Fifth—A live load on each foot-walk of 200 lbs. per lineal foot.

The trusses are now under construction by the Detroit Bridge and Iron Works, and the Dominion Bridge Company. Of the 25 spans, 19 will be turned out by the former company, and six by the latter.

At the present time the masonry of the piers is undergoing the extension necessary to meet the requirements of the enlarged bridge. It is expected that work will be commenced on the erection of the new bridge about the middle of August, and it is the intention to have the whole of the work completed by the 1st June, 1898.

On the application of Edward Major, a creditor, an order of the court has been granted for the winding up of the Canadian Mineral Wool Co., of Toronto, as insolvent.




*For* The Canadian Engineer.

## WATER LIFT.

This sketch illustrates a new system of water lift, which is claimed to be especially adapted to the displacement of heavy fluids, and in shallow lifts will have the advantage in not having to raise the water any higher than required to effect the discharge. The sketch is one-sixteenth to the foot of a combination to discharge 500 cubic feet per second over an embankment six feet high.

There are two wedged-shaped dippers, *A*, pivoted at the small end and suspended by lifting arms at lower end. There are 4 spur wheels which form the cranks ; there is also a cross shaft upon which are secured 4 pinions, which engage the 4 spur wheels in such a manner as to require one of the dippers to descend while the other is coming up, thus effectually balancing the dippers and all other parts. A large valve is placed at *B*, through which the burdened water enters while the dipper is descending.

The motive power will be applied to the pinion shaft in any manner deemed best. This lift is the invention of Wm. Golding, New Orleans, Va.

## NATIONAL CONVENTION OF MASTER PLUMBERS OF CANADA.

The first four days in July were marked by the meeting of the Master Plumbers of Canada in Toronto for their second annual convention. There were thirty-four delegates present against eighteen last year at the first convention. The representation was one delegate to every ten members, The following delegates were present :

Quebec—R. Sampson, A. Forrest, J. R. Cane, J. O. Matte, A. Pickard. Montreal—Thos. Moll, E, C. Thibault, J. W. Harris, John Watson, P. C. Ogilvie, Arthur Martin. P. J. Carroll, E. C. Mount, Wm. Briggs, J. W. Hughes, Joseph Lamarche. Windsor, Ont.—M. B. Squires, Halifax—John Borton, Geo. A. Perrier. Ottawa—John McKinley, F. J. Johnson. St. John, N.B.—W. H. Dunbrack, J. H. Doody. St. Catharines—J. A. Caslake. Toronto—J. B. Fitzsimons, Joseph Wright, A. Purdy, H. Beavis, J. K. Allison. Winnipeg—J. W. Hughes. London—W. H. Heard, W. Smith, E. Holland, Benjamin Noble. West Toronto Junction—Represented by the five Toronto delegates. St. Thomas—W. Flaherty. Peterborough—Adam Hall. The Executive Committee reported that during the year local associations in affiliation with the Dominion Association had been organized in Winnipeg, Man., and Windsor, Stratford, St. Thomas, and St. Catharines, Ont. Negotiations are now going on that will, it is hoped, result in the formation of an Association in Vancouver, B.C.

Notice was given of a motion to form Provincial organizations, each to be part of the larger association, whose officers would then be known as the supreme officers.

Drafts of by-laws which the association will endeavor to have passed in the various municipalities were submitted to the association. They comprised by-laws to license and regulate plumbers; to provide plumbing inspectors, plumbing examiners and their duties. The legislative committee reported against the proposed incorporation of the association.

President Lamarche reported the progress of the association during the first year of its existence. A great deal of work had fallen on the officers, and a great deal of correspondence had been necessary in perfecting their organization. The resolution of the master plumbers had been signed by most of the wholesale dealers in Toronto, Montreal and Quebec. He urged the members to be most careful in sending the names of all master plumbers in their neighborhood, so that the wholesale men should know the names of all the master plumbers. The president said : " Too much trouble cannot be taken to see that this is carried out, as the wholesale men are not able to distinguish between master plumbers, journeymen plumbers and contractors. If a man comes in the store with his money, calling himself a master plumber, the wholesale man will not nor cannot take time to go after possible information to see if he is the right man to whom he should sell It is, therefore, our duty to see that they receive a complete list of *bona fide* master plumbers, monthly notices of changes, and the deserved help from us. Complaints of the agreement

being broken should always be very carefully made and positive proof sent in to the National office. It alone has a right to deal with trade relations which have been decided by the convention."

The new officers elected are :—President, Joseph Wright, Toronto; vice-president, W. Smith, London; vice-president for Ontario, John McKinley, Ottawa; vice-president for Quebec, P. J. Carroll, Montreal; vice president for New Brunswick, J. H. Doody; vice-president for Nova Scotia, John Borton, Halifax; vice-president for Manitoba, —. Irwin, Winnipeg; secretary, —. Mansell; treasurer, W. Briggs, Montreal; executive committee, one from each Province—Ontario, J. B. Fitzsimons, Toronto; Quebec, Arch. Picard, Quebec; New Brunswick, Thomas Campbell, St. John; Nova Scotia, Geo. A. Perrier; Manitoba, —. Stevenson, Winnipeg.

The social features of the convention included a drive given the members by the city, a banquet and a trip to Niagara Falls. The banquet was a magnificent affair, and was held in the Harry Webb Co.'s building, Yonge and Melinda streets. About 140 members and guests sat down to a dinner which was beautifully served and in which every dish was well worth the serving. Chairman Burroughes opened the toast list and a couple of hours were spent in speeches and song.

## DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.*

BY WILLIAM THOMPSON, MONTREAL WEST.

The principle of getting the best returns and most efficient service should underlie our system of purchasing our fuel, as of anything else. It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose. Undoubtedly the most correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use, except by the expert chemist in his laboratory. Efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. That published by Dulong and also by Mahler, is perhaps the best. It is based upon an elementary analysis of the coal under examination, and the fact that the heating powers of coals of a like composition remained constant. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen. Dulong accepts as the heat-producing elements of coal, carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailing for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula :

$$Q = 14{,}544\ C + 62{,}100\ (H - O_8)$$

which for convenience might be written :

$$Q = 14\ 544\ C + 62{,}100\ H - 7{,}762.50$$

Where Q equals calorific value of fuel,

14,544 = constant heating power of carbon
62,100 = " " " hydrogen
7,762.5 = " neutralizing power of oxygen

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14.52 B.T.U., and using the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became :

$$Q = 14{,}652\ C + 62{,}100\ H - 5{,}400\ (O + N)$$

Where Q equals calorific value of coal,

14,652 = constant value of carbon
62,100 = " " hydrogen
5,400 = " neutralizing effect of oxygen, less heat formed by formation of nitric acid, ($N_2 O_5 + H_2 O$) †

*Abstract of a paper read before the Canadian Electrical Association.

† $N_2 O_5 + H_2 O = 2\ H N O_3$. The calorific value of 1 lb. nitric acid equals 187.79 B. T. U.

Both of these formulas are based upon an elementary analysis, which is difficult to make, and will give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula constructed on the basis of a proximate analysis. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the moisture, volatile combustible matter, fixed carbon, and ash. The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal published in Progressive Age, Jan. 15, 1897, the following formula :

$$Q = 14670\ F.\ C. + A \times \text{volatile matter.}$$

when Q equals calorific value of coal.

14670 = constant heating power of fixed carbon,
A = 23400 when volatile matter equals from 2 per cent. to 15 per cent. of total combustible.
A = 18000 when volatile matter equals from 15 per cent. to 30 per cent. of total combustible
A = 17100 when volatile matter equals from 30 per cent. to 35 per cent. of total combustible.
A = 16200 when volatile matter equals from 35 per cent. to 40 per cent. of total combustible.

This formula may be taken as useful for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35 per cent. of total combustible.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric values of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals decreases almost in the same proportion that volatile combustible increases.

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of exygen in the combustible, and the heating value of the hydrogen in the combustible will decrease in proportion to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. The actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases. We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of smoke, varying in density and volume according to the quantity and composition of the volatile combustible matter in our fuel.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel, but we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes, as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial

benefit in enabling engineers to arrive at the steam-making capacity of their coals .

$$Q = 14652 + c. + A \times \text{volatile matter} \times B.$$

Where A equals 23,400 when volatile combustible is equal to from 2 to 15 per cent. of total combustible,

A equals 20,000 when volatile combustible equals from 15-30 per cent. of total combustible,

A equals 17,100 when volatile combustible equals from 30.35 per cent. of total combustible.

A equals 16,200 when volatile combustible equals from 35-40 per cent. of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90 per cent. of total combustible,

B equals .65 when fixed carbon equals 74-82 per cent. of total combustible,

B equals .662 when fixed carbon equals 68.74 per cent. of total combustible,

B equals .551 when fixed carbon equals 50-60 per cent. of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal. With this formula and the proximate analysis before us, we are readily enabled to determine which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

In presenting his paper Mr. Thompson said the present mode of determining the efficiency of boilers and furnaces was somewhat crude. We can with a little practice determine the heat-producing value of the coal we are using, but we want to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way : We start by knowing the maximum quantity of heat that the coal will give ; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion.

Mr. Milne : The determination of the heat value in coal is generally done by three methods; first, chemical analysis ; second, by combustion in a coal calorimeter ; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much ; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal that we are going to get for that day is of the same quality, because, although you are getting coal from the same mine, you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. There is an instrument—probably my friend Mr. Thompson is acquainted with it ; it is invented by a Mr. Thompson and is used by the North British and some of the leading railways in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal ; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water one degree Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning ; that would give you the exact heat value in the coal. I think that is the simplest method, and it is accurate enough for all practical purposes.

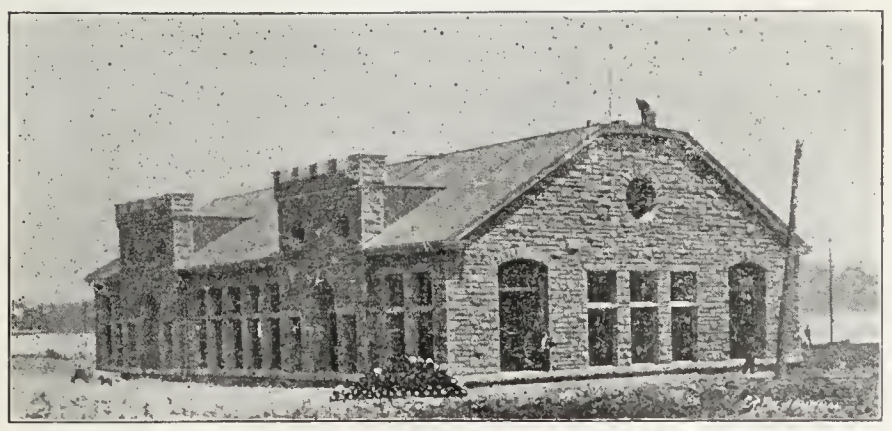
Mr. Thompson said he knew the instrument referred to, but did not consider it reliable. In dealing with so small a quantity of fuel the metal itself absorbed enough heat to lead one astray. He did not say the instrument was useless, but the average engineer is not able to use it. As to the value of a calorimeter, he heard that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel ? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. He then described his own method as follows : I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible ; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see ; he would make an effort to get as nearly as possible an average sample, then the making of the proximate analysis becomes an easy matter. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens said these ideas were right for a large plant, but the average engineer is not expert enough at such delicate tests to get correct results. A firm burning say $2,000 worth of coal a year, hardly pays enough for an engineer of such ability. The ordinary engineer goes at it in a thumb-handed way, but he is often as near right as the scientific man. He doubted whether there was an expert in one of our colleges who could declare that he was absolutely correct. He finds he has to allow for this and that, and it is partly guess-work.

Mr. Wright said it was nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample.

## THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

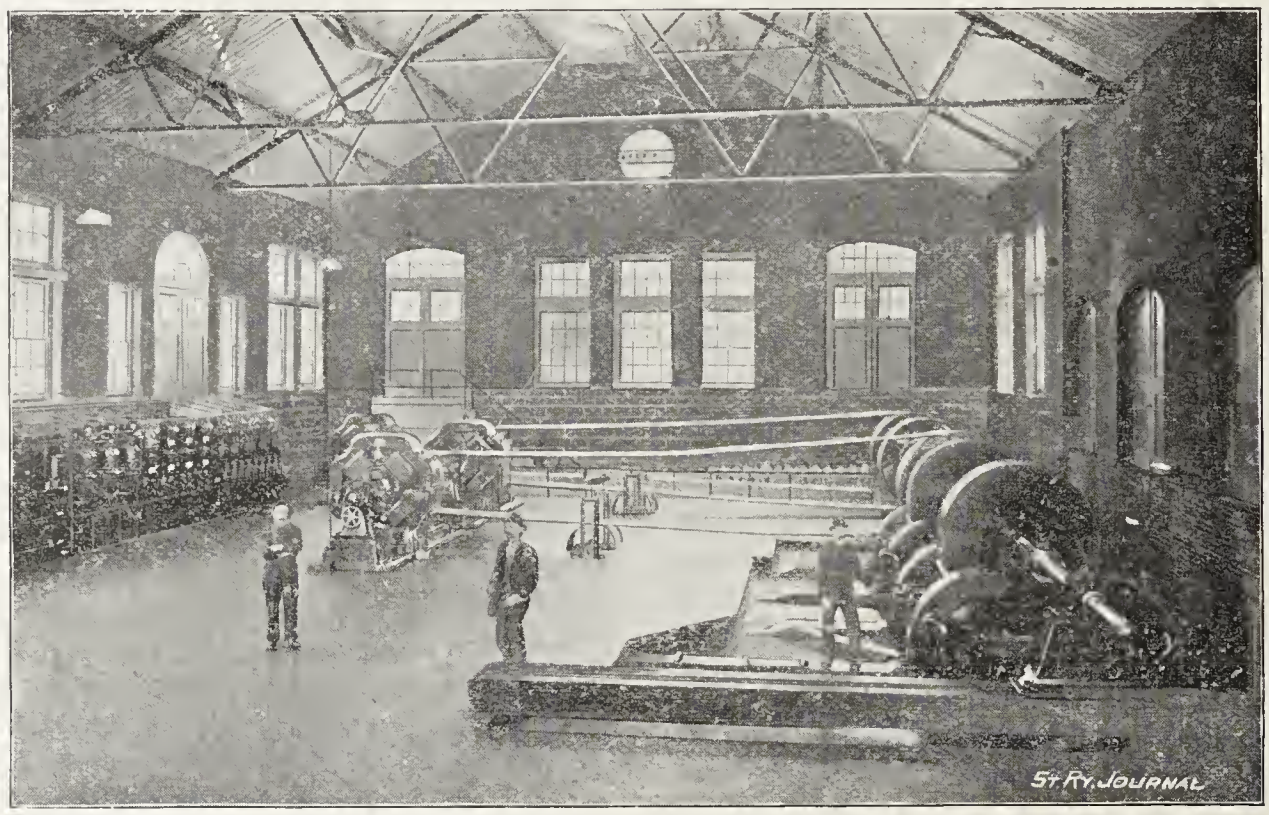
At the convention of the National Electric Light Association at Niagara Falls, N.Y., in June, there were a number of Canadians well-known in electrical circles on both sides of the line. Among them were noticed F. C. Armstrong, Toronto; T. A. Badger, jr., Quebec; E. B. Biggar (THE CANADIAN ENGINEER); F. A. Bowman, New Glasgow, N.S.; John Carroll, Montreal; Prof. C. A. Carus-Wilson, Mon-



NIAGARA FALLS PARK AND RIVER RAILWAY POWER HOUSE.

treal; E. E. Cary, St. Catharines; E. T. Freeman, Halifax, N.S., W. A. Johnson, Toronto; J. A. Kammerer, Toronto; R. S. Kelsch, Montreal; John Langton, Toronto; Frank LeBlond, Niagara Falls, Ont.; E. D. McCormack, Toronto; Charles Morton, Montreal; John Murphy, Ottawa; Frederic Nicholls, Toronto; Geo. A. Powell, St; Catharines, Ont.; J. F. Rothsay, Niagara Falls, Ont.; A. E. Smaill, Montreal; W. McLea Walbank, Montreal; Geo. W. Watts, Toronto.

The president, Frederic Nicholls, to whose most able management of the affairs of the association during his term of office we referred in




NIAGARA FALLS PARK AND RIVER RAILWAY—INTERIOR OF POWER HOUSE.

our last issue, stated in the opening address the reasons for the selection of Niagara Falls as the place of meeting, on account of its pre-eminence as an electrical power distribution centre.

"In this connection, I am of the opinion," said Mr. Nicholls, "that the lecture to be given by L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo; Mr. Stillwell's paper will set forth the various actual appliances of Niagara power at the present time, including transmission to Buffalo, and future presi-

NIAGARA FALLS PARK AND RIVER RAILWAY—BRIDGE AT DUFFERIN ISLAND.

dents of this association will, in all probability, refer to his paper and draw comparisons when adverting to the strides which will then have been made in the wider utilization of this mighty power, which for countless ages has been simply running to waste, so far as any economic use is concerned, and apart from its value as the greatest scenic wonder of the world. I fully appreciate the honor of presiding at this meeting, which, for the reasons I have just referred to, will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry and it is therefore with more than ordinary satisfaction that I am authorized to state that at no previous period has this association been as prosperous, shown greater vitality, or commanded such respect. It is now an acknowledged authority on matters electrical, its membership confers a privilege that has more than a sentimental value, and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection. In union is strength, and to-day our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the finance committee will show that after making provision for all expenditures necessary to maintain the usefulness of the association, an unusually large credit balance is at your disposal. It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence, and the more recent meetings have been remarkable for the greater interest that has been taken in the actual work of the association, and the lesser attention that has been given to the merely social and entertainment features of the programme. At this meeting, although offers of entertainments and privileges had been numerous, only those from electrical concerns had been accepted, it being felt that this was more purely a business meeting, held for the furtherance of the immediate objects of the association." In conclusion, President Nicholls said that the asso-

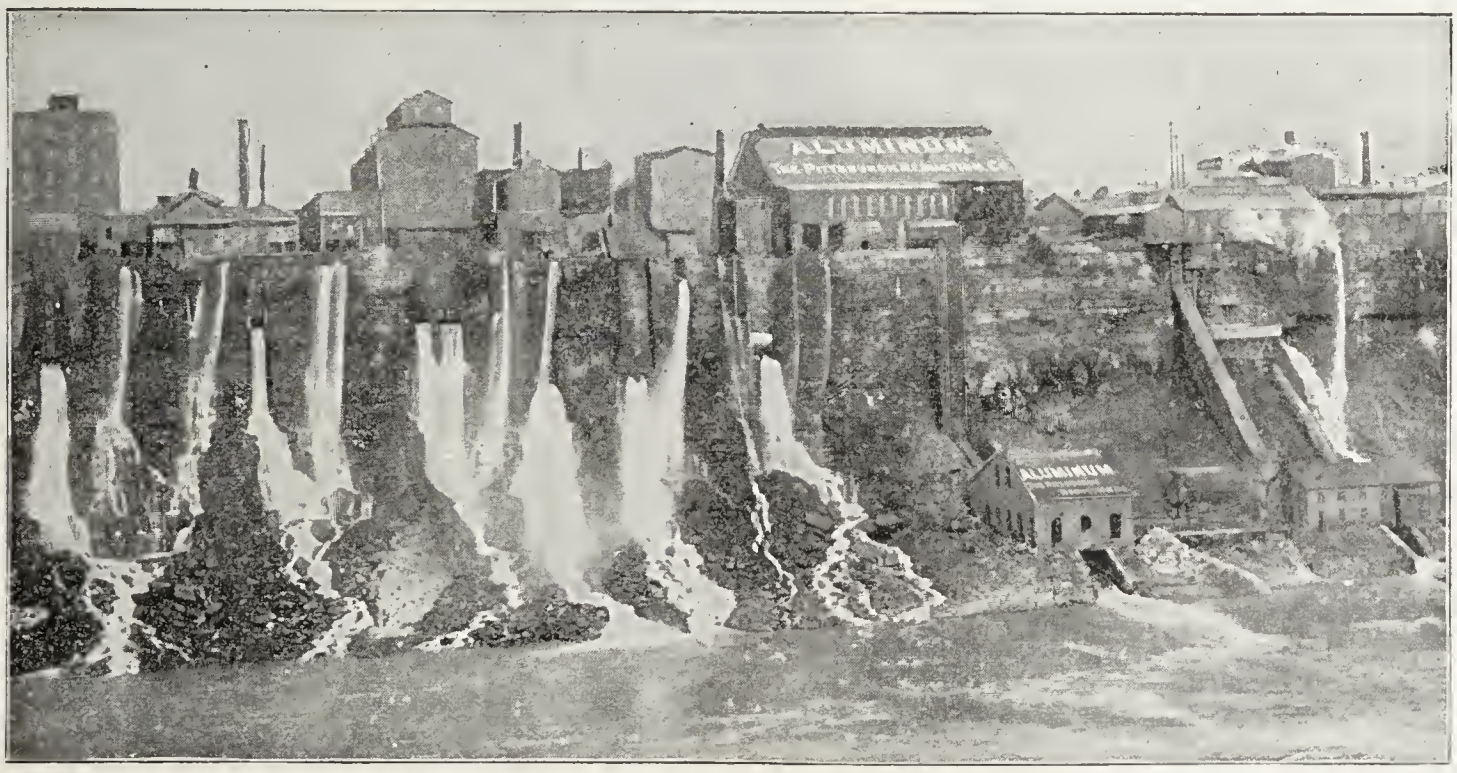
ciation and the electrical profession owed a deep debt of gratitude to the electrical press, and that the importance of its labors in behalf of electrical industries could hardly be over-estimated.

The Committee on Data made its report through H. M. Swetland, its chairman. It embodies the results obtained by an engineering expert engaged for this purpose, but covers only fourteen plants. The majority of station managers object to the publication of their data, hence the restricted ground of the report. The report of the Finance Committee showed that the association possessed net assets of $52,572.23, of which $1,385.94 consisted of cash, and that there was no indebtedness.

J. B. Cahoon, Elmira, N.Y., read a paper on "The Establishment of a Base Price for Current," which dealt chiefly with the lack of knowledge of the cost of incandescent lights, and the difference between charges for these lights and arcs. He thought the variation in cost between place and place should be largely based on the price of coal. The Committee on Wiring brought in a code which it was hoped would unite the interests of those who are insured and those who do the work in the adoption of a common standard code. The code was adopted.

J. G. White, in his paper on "The Niagara Power Transmission Line," included an interesting review of the history and an account of the construction of the line, and the reasons adopted for the various specific modifications in the usual design of power transmission lines adopted in this instance. At its conclusion Mr. White explained that it was perfectly practicable to replace insulators on the line without shutting off the current. This has been done by the use of a large insulated stool, on which a ladder is placed, or by handling the wire with an insulator mounted on the top of a pole, which is forced up under it, thus lifting it up off of the pin insulator and permitting the ladder to be replaced. With current of 10,000 volts the capacity of a man is sufficient to cause a flow of current which will give him a considerable shock, and a nervous man might be knocked off the ladder by this. The consequence is that replacing insulators is neither a very safe nor a very pleasant task. The lightning arrester problem is still in process of solution, and is largely in the experimental stage. The line is protected by barbed fence wires, which are run on top of the poles and on the outer end of the cross-arms, in a little fork at the top of an iron pin stuck through the end of the arm. At every fifth pole these fence wires are grounded with a number six copper wire running to a coil at the bottom of the pole.

PICTURESQUE NIAGARA—THE CANADIAN SIDE.




INDUSTRIAL NIAGARA—THE AMERICAN SIDE.

Arthur Wright, of Brighton, England, read a summary of his paper on "Profitable Extension of Electricity Supply Stations." This was an interesting thesis upon the desirability of domestic lighting and of certain other forms of custom which can be secured by the use of more equitable systems of charging for current. The author contended that the only available method is the sliding scale of hours of consumption. This paper was followed by a long discussion. Mr.

Wright, in replying to a number of questions, gave the practical details of the operation of his system in Brighton; the instruments used sum up the consumer's bills without the necessity for any calculation, and could be read by an ordinary meter reader. In reply to further questions Mr. Wright stated that the maximum demand was measured by a recording ammeter, which is used during the four winter months, and its maximum for that time taken as the maximum demand.

At the closing session of the convention Lieut. F. Jarvis Patten, of New York, presented his paper on "Frequency Transformation," and C. F. Scott, of Pittsburg, read his paper on "Rotaries for Transforming Alternating into Direct Current." The report of the committee on Standard Candle Power of Incandescent Lamps was also presented by James I. Ayer, Dr. Louis Bell, the chairman of the committee, not being present. This report will be found in another column.

The officers which were elected to preside over the destinies of the association during the coming year were: Samuel Insull, of Chicago, president: A. M. Young, of Waterbury, Conn., first vice-president; George R. Stetson, New Bedford, Mass, second vice-president. The following were chosen as members of the executive committee: Frederick Gilbert, Boston; W. Worth Bean, St. Joseph, Mich.; Mr. Stevens, Elizabeth, N.J.; W. McLea Walbank, Montreal.

The views of Niagara Falls and its neighborhood on both sides of the river, which we give in connection with this report of the National Electric Light Association, were crowded out of our report of the Canadian Electrical Association's meeting in our July number.

## CANADIAN ASSOCIATION STATIONARY ENGINEERS.

We report the results of the annual election in the different branches C.A.S.E., in addition to those which appeared in the July number of THE CANADIAN ENGINEER, as follows:

Hamilton—Wm. Norris, president; G. Mackie, vice-president; Joseph Ironside, recording secretary, Markland street.

Stratford--John Hoy, president; Samuel H. Weir, secretary.

Brantford—J. B. Forsyth, president; Joseph Ogle, vice-president; T. Pilgrim, Continental Cordage Company, secretary.

London—D. G. Campbell, president; B. Bright, vice-president; W. Blythe, secretary.

Guelph—H. Geary, president; Thos. Anderson, vice-president; H. Flewelling, recording secretary; P. Ryan, financial secretary; C. F. Jordan, treasurer.

Ottawa—Frank Robert, president; T. G. Johnson, secretary.

Peterborough—W. L. Outhwaite, president; W. Forster, vice-president; A. McCallum, secretary.

Brockville—Archibald Franklin, president; John Grundy, vice-president; James Aikins, recording secretary.

Carleton Place Branch No. 16—Joseph McKay, president; J. D. Armstrong, secretary.

Kincardine—Daniel Bennett, president; Joseph Lighthall, vice-president; Percy C. Walker, secretary, waterworks.

Dresden—Thos. Steeper, secretary.

Berlin—J. R. Utley, president; G. Steinmetz, vice-president; secretary and treasurer, W. J. Rhodes, Berlin, Ont.

St. Laurent—R. Drouin, president; Alfred Latour, secretary, 306 Delisle street, St. Cunegonde.

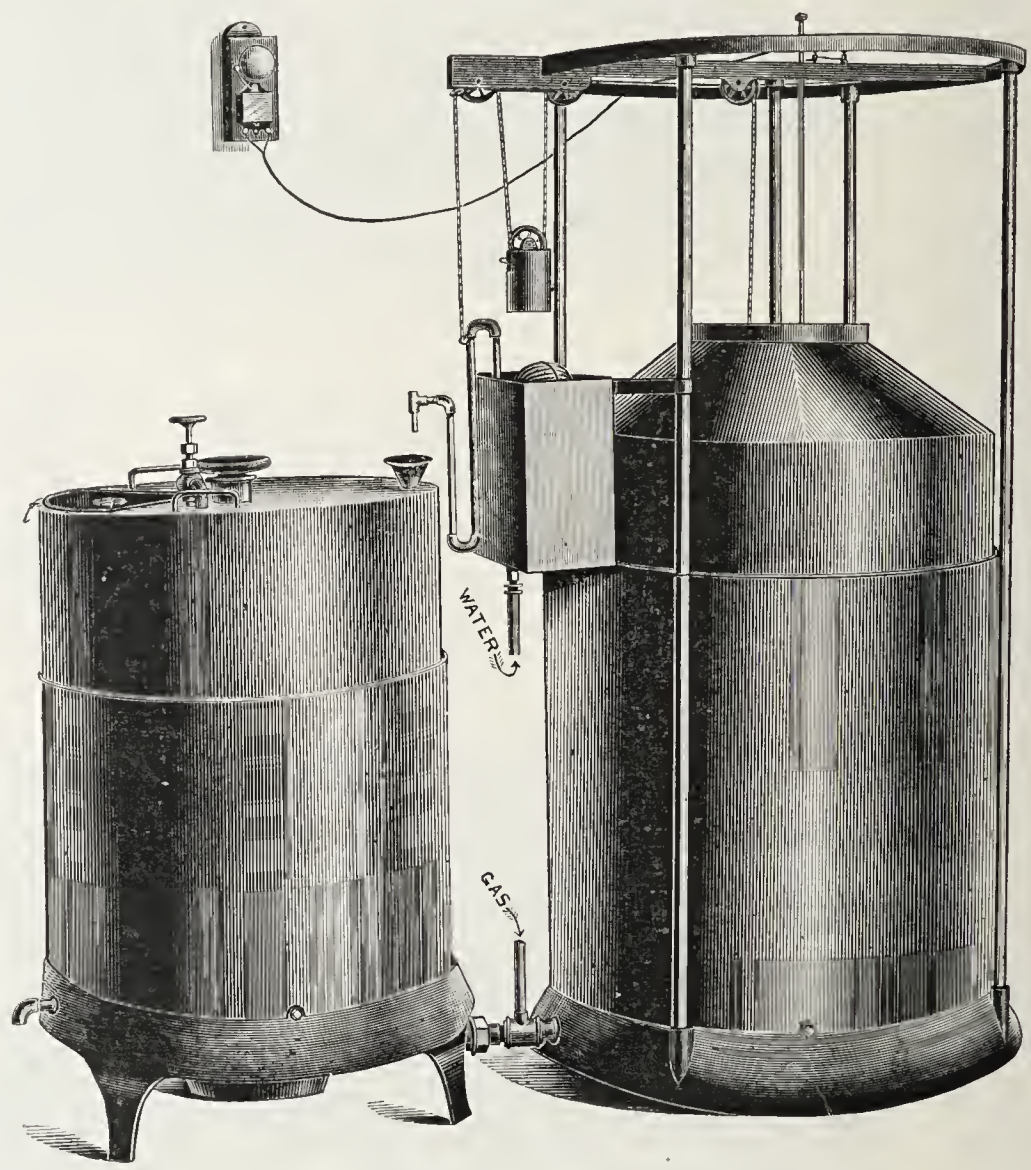
Brandon, Man., Branch No. 1.—A. R Crawford, president; Arthur Fleming, secretary.

Winnipeg—G. M. Hazlett, President; J. Sutherland, rec. secretary; A. B. Jones, financial secretary.

## A NEW ACETYLENE GAS GENERATOR.

The success of any acetylene gas generating apparatus depends largely on the regulation of its water supply to the carbide. In the machine here illustrated, the device for this purpose can be said to be both old and new; old, in being a syphon, the common principle of which has been known for ages; new, in its ingenious arrangement whereby the discharging end of the syphon can be raised above its source of supply, thereby arresting its operation without causing the water in it to "break" and run back to the supply tank, as would occur in doing this with the old simple form of syphon; yet it has no valves or obstructions contained within it, simply a crooked piece of pipe. The secret of its operation is contained in the crook; it will be observed that the water must enter that end of the syphon immersed in the tank and pass up over the edge of the tank, then down again to near the bottom of the tank, where it again takes an upward turn, its end terminating in a spout about on a level with the top of the tank. The "U" shaped bend on the outside of the tank serves to contain sufficient water to more than counterbalance that of the column in the pipe within the tank; hence, when the discharging end of the syphon is raised above the water in the tank the lower part of the syphon outside the tank is still below it. If the discharging end of the syphon be lowered slightly below the surface of the water in the tank, water starts to run, increasing in volume as the syphon is lowered; thus a simple and efficient means is provided for regulating the supply of water, a drop or a stream being furnished as required, depending on the number of lights in use.

The illustration shows the machine in its working position, the gasometer top being at a height just sufficient to stop the flow of water from the syphon, the discharging end of which is shown as just above the water in the small tank to which it is connected; a slight lowering of the gasometer dome pulls downward on the chain, which is attached to the gasometer




A NEW ACETYLENE GAS GENERATOR.

dome, and which passes over pulleys to the syphon. As the dome descends the chain is drawn around the pulleys in the weight until a small obstruction, on the chain, reaches the weight, when the latter is lifted entirely by that part of the chain below the weight, and the gasometer dome. This takes the tension from that part of the chain going to the syphon, when the latter lowers from its own weight, till its discharging end becomes lower than the water in the supply tank; water then flows from the syphon to the carbide in the generator, gas is generated, which passes to the gasometer, and the dome of the latter raises again till the obstruction on the chain passes from the weight, when the latter, exerting its weight equally on both ends of the chain, overcomes the weight of the syphon, causing it to raise till the discharging end is again above the water in the tank. The syphon is prevented from raising too high by an obstruction on the chain, which comes in contact with the pulley over which the chain passes, just above the syphon. The dome of the gasometer is guided up and down by a central rod extending from the frame above, down through a tube in the gasometer dome; the lower end of the rod is

secured in a socket in the bottom of the gasometer. The tube through which the rod passes serves to prevent the escape of gas from the gasometer, as its lower end reaches into the water in the gasometer sufficiently to prevent this, the tube also serving to hold the dome in position. Experience has shown this to be the simplest and best method of guiding the dome without effecting the pressure of gas in the gasometer or the steadiness of the lights in the slightest degree.

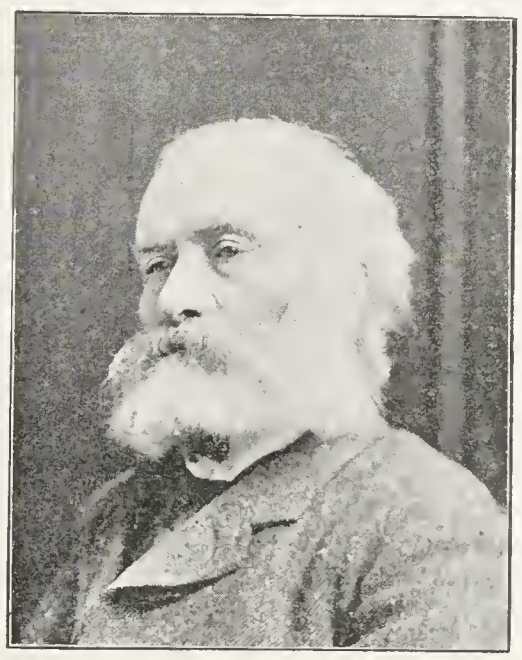
The desirability of some simple means for preventing the accumulation of more gas in the machine, from any reason whatever, than it can safely contain, and which will prevent the pressure of the gas from increasing its normal condition, is conceded not only to be a distinct advantage to the machine itself, but an absolute necessity. This feature of an acetylene gas machine is like the safety valve on a steam boiler; it is placed there, not for the purpose of using it, but to prevent an accident by interference with the working of the machine, either by design or otherwise. To accomplish this desirable object, a large tube, six or eight inches, is connected to the dome of the gasometer and reaches down to within a few inches of the bottom of the dome, passing up through the bottom of the gasometer, and slightly above the water therein, and within the tube referred to is an overflow pipe, the outer end of which can be carried without the building if desired. In operation, should the dome of the gasometer ascend sufficiently to cause the suspended tube to be raised out of the water in the gasometer, the gas would pass within said tube, where it would enter the overflow pipe, and be carried to the outside of the building. When the gasometer dome again descends the tube enters the water, inclosing within it the overflow pipe, which prevents any further escape of gas. It will therefore be readily seen that a simple and sure means is provided for the protection of the machine, and the prevention of the escape of gas within the building. It will also be readily understood that this arrangement does not operate by friction, or in any way vary the pressure of gas.

An appreciable improvement, has, it is claimed, been made in the construction of the gasometer. By reference to the engraving it will be seen that the upper part of the generator slides within the lower part, double walls in the lower part being provided for, the space between the two walls into which the upper part of the generator slides is filled with a liquid, which provides an effective seal to prevent the escape of gas. Within the generator is a round table, which turns on a shaft that extends through a liquid seal to the top of the generator. This table has a rim around it, several inches deep; within the table is secured four cells, separated from each other about half an inch, the space between them and within the rim of the table being filled with an inexpensive liquid, whose presence does not cause moisture, hence no gas is generated. Suspended from the top of the generator, at a position just above one of the cells, is a tube, open at both ends and slightly larger than the cells, in the table. The top of this tube is closed by a liquid sealing cover, which enters double walls. In the top of the generator beneath the discharging end of the syphon, is seen the funnel-shaped opening, into which water passes, to reach the carbide, which is placed in cans, and set within the cells on the table. To operate the generator, the top is pressed down as far as it will go. This causes the tube connected with the generator to surround one of the cells which is directly beneath it. The tube entering the liquid surrounding the cell, completely isolates the cell from the remainder of the generator. The cover over the top of the tube, now being removed, the can within the cell and containing the spent carbide, is exposed, the escape of gas from the generator being prevented by the lower end of the tube being immersed in the liquid in the table. To replenish the supply of carbide, the can containing the spent carbide is removed, and a fresh can set within the cell. The cover is then replaced and the catch which held the top down, released, when the top of the generator raises of itself by the pressure of the gas in the gasometer, which passes into the generator, as its top continues to raise, this gas having originally passed from the generator to the gasometer when the top of the former was pressed down and the gasometer dome rose to accommodate it. When it is necessary to replenish another cell, the table is turned by grasping a wheel on the top of the generator, and giving it a quarter turn, its correct position being indicated by a rib on the base of the table engaging in a slot on the bearing, on which the table turns. It will thus be seen that the spent carbide can be removed and the supply replenished while the machine is in operation without the escape of gas and without soiling the hands, the whole operation requiring less than two minutes' time.

As the odor from acetylene gas is decidedly objectionable, it will thus be seen what desirable features this apparatus contains, in not permitting the escape of gas at any time, within the house or other building within which it is kept. The exhaustion of the cells is indicated by an electric bell connected by wires to the gasometer, and located any desirable place within the building. When the alarm is given it is only necessary to turn the wheel on the top of the generator one-quarter of a revolution. This turns the table in a like manner, and places a fresh cell of carbide beneath the water feed. The operation requires but a moment's time.

From this extended description it must not be inferred that the machine is complicated, having respect to what the machine accomplishes. It is quite the reverse. The machine here illustrated is capable of sustaining from fifty to a hundred lights. A machine suitable for lighting residences where but ten to twelve lights are required is made in a modified form, the gasometer and generator being constructed together, so that little space is occupied. Arrangements for the manufacture and sale of this invention will be made at once. Those interested in acetylene gas lighting may communicate with Messrs. Kerr & Fry, of Niagara Falls, Canada, who at present control the patents.

## SIR SANFORD FLEMING.



Sanford Fleming, K.C.M.G., LL.D., C.E., Ottawa, is the most prominent and original of Canadian civil engineers. He was born at Kirkcaldy, Fifeshire, Scotland, January 7th, 1827. He received his early education near his birthplace, and came to Canada at the age of eighteen. He was on the engineering staff of the Northern Railway from 1852-1863, the latter half of service being as chief engineer. In 1863 he was sent as delegate to the Imperial Government in reference to a railway from the Provinces of Canada to British Columbia. He was appointed in 1863 by Governments of Canada, New Brunswick and Nova Scotia, and by the Imperial Government, chief engineer of the Intercolonial Railway. In 1871 he was made engineer-in-chief of the Canada Pacific Railway. When the construction of the C.P.R. was well advanced, political questions arose, and in 1880 he resigned—and though he was not thereafter concerned in the construction of the work, no one has sought to take away from him the reputation of the pioneer engineer of Canada, and the country's benefactor. On his retirement in 1880, he was elected Chancellor of Queen's University, re-elected 1883, 1886, 1889 and 1892. In 1884 he received the honorary degree of LL.D., from St. Andrew's University, Scotland. In 1881 he went as delegate from the Canadian Institute and Meteorological Society to the International Geographical Congress, at Venice, and in 1884 he was appointed delegate of Great Britain to represent the Dominion at the International Prime Meridian Conference at Washington. Mr. Fleming was engineer of the Hoosac tunnel, the greatest achievement of its kind at the time of its construction. Mr. Fleming has been a contributor to various scientific and other publications, and has been a mover in the "time reform" and Pacific cable movements. Mr. Fleming married in 1855 Miss Hall, daughter of Sheriff Hall, Peterboro', Ont. On the occasion of the Queen's Diamond Jubilee, no honors were more worthily bestowed than that of knighthood conferred on Sir Sanford Fleming.

## THE NEW METAL TARIFF.*

The following is the new Canadian tariff, as now officially proclaimed, affeeting the iron and other metal trades, and including building material :

EARTHENWARE, CEMENTS, SLATE AND STONEWARE.

Building brick, paving brick, stove linings, and fire brick, n.e.s., and manufactures of clay or cement, n.o.p., 20 per cent. ad valorem.

Earthenware and stoneware, viz.: demijohns, churns or crocks, 30 per cent. ad valorem.

Drain tiles, not glazed, 20 per eent. ad valorem.

Drain pipes, sewer pipes, ehimney linings, or vents, chimney tops and inverted blocks, glazed or unglazed, and earthenware tiles, 35 per cent. ad valorem.

China and porcelain ware, also earthenware and stoneware, brown or colored and Rockingham ware, white granite or iron stoneware, "c.c." or cream-colored ware, decorated, printed or sponged, and all earthenware, n.e.s., 30 per cent. ad valorem.

Baths, tubs and wash-stands of earthenware, stone, cement, or clay, or of other material, n.o.p., 30 per cent. ad valorem.

Cement, Portland and hydraulic or water lime, in bags, barrels or casks, the weight of the package to be included in weight for duty, 12½ eents. per one hundred pounds.

Plaster of Paris, or gypsum, ground, not calcined, 15 per cent. ad valorem.

Plaster of Paris, or gypsum, calcined or manufactured, the weight of the package to be included in the weight for duty, 12½ cents per one hundred pounds.

Lithographic stones, not engraved, 20 per cent. ad valorem.

Grindstones, not mounted, and not less than 36 inches in diameter, 15 per cent. ad valorem.

Grindstones, n.e.s., 25 per cent. ad valorem.

Flagstones, sandstone and all building stone, not hammered or chiselled ; and marble and granite, rough, not hammered or chiselled, 15 per cent. ad valorem.

Marble and granite, sawn only ; flagstone and all other building stone, dressed ; and paving bloeks of stone, 20 per cent. ad valorem.

Marble and granite, n.e.s., and all manufactures of marble or granite, n.o.p., 35 per cent. ad valorem.

Manufactures of stone n.o.p., 35 per cent. ad valorem.

Roofing slate, 25 per cent. ad valorem ; provided that the duty shall not exceed 75 eents per square.

Slate mantels and other manufactures of slate, n.es., 30 per cent. ad valorem.

Slate pencils and school writing slates, 25 per cent. ad valorem.

Mosaic flooring of any material, 30 per cent. ad valorem.

METALS AND MANUFACTURES OF

Iron or steel scrap, wrought, being waste or refuse, including punchings, cuttings of clippings of iron or steel plates or sheets having been in actual use; crop ends of tin plate bars, or of blooms, or of rails, the same not having been in actual use, one dollar per ton.

Nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be re-manufactured in rolling mills.

Iron in pigs, iron kentledge, and cast scrap iron, two dollars and fifty cents per ton.

Ferro-silicon, ferro-manganese, and spiegeleisen, 5 per cent. ad valorem.

Iron or steel ingots, cogged ingots, blooms, slabs, billets, puddled bars and loops or other forms, n.o.p., less finished than iron or steel bars, but more advanced than pig iron, except castings, two dollars per ton.

Rolled iron or steel angles, tees, beams, channels, girders and other rolled shapes or sections, weighing less than 35 pounds per lineal yard, not punched, drilled or further manufactured than rolled, n.o.p., seven dollars per ton.

Rolled iron or steel angles, tees, beams, channels, joists, girders, zees, stars, or other rolled shapes, or trough, bridge, building or structural rolled sections or shapes, not punched, drilled or further manufaetured than rolled, n.e.s., and flat eye-bar blanks not punched or drilled, 10 per cent. ad valorem.

Bar iron or steel, rolled, whether in coils, rods, bars or bundles, comprising rounds, ovals and squares, and flats ; and rolled shapes, n.o.p.; and rolled iron or steel hoop, band, scroll or strip, eight inches or less in width, number eighteen gauge and thicker, n.e.s., seven dollars per ton.

Universal mill or rolled edge bridge plates of steel when imported by manufacturers of bridges, 10 per cent. ad valorem.

Rolled iron or steel plates not less than thirty inches in width, and not less than one-quarter of an inch in thiekness, n.o.p., 10 per cent. ad valorem.

Rolled iron or steel sheets or plates, sheared or unsheared, and skelp iron or steel, sheared or rolled in grooves, n.e.s., seven dollars per ton.

Skelp iron or steel, sheared or rolled in grooves, when imported by manufacturers of wrought iron or steel pipe for use only in the manufacture of wrought iron or steel pipe in their own factories, 5 per cent. ad valorem.

Rolled iron or steel sheets number seventeen gauge, and thinner, n.o.p.; Canada plates ; Russia iron ; flat galvanized iron or steel sheets, terne plate, and rolled sheets of iron or steel coated with zinc, spelter or other metal, of all widths or thickness, n.o.p., and rolled iron or steel hoops, band, seroll or strip, thinner than number eighteen gauge, n.e.s., 5 per cent. ad valorem.

Chrome steel, 15 per cent. ad valorem.

Steel, in bars, bands, hoops, scroll or strips, sheets or plates, of any size, thickness or width, when of greater than two and one-half cents per pound, n.o.p., 5 per cent, ad valorem.

Swedish rolled iron and Swedish rolled steel nail rods under half an inch in diameter for the manufacture of horse-shoe nails, 15 per eent. ad valorem.

Iron and steel railway bars or rails of any form, punched or not, n.e.s., for railways, which term for the purpose of this item shall include all kinds of railways, street railways and tramways, even although they are used for private purposes only, and even although they are not used or intended to be used in connection with the business of eommon carrying of goods or passengers, 30 per cent ad valorem.

Railway fish plates and tie plates, eight dollars per ton.

Switches, frogs, crossings and intersections for railways, 30 per cent. ad valorem.

Locomotives for railways, n.e.s., 35 per cent. ad valorem.

Iron or steel bridges, or parts thereof ; iron or steel structural work, eolumns, shapes or sections, drilled, punched or in any further stage of manufacture than as rolled or cast, n.e.s., 35 per cent. ad valorem.

Forgings of iron or steel of whatever shape or size or in whatever stage of manufacture, n.e.s.; and steel shafting turned, compressed, or polished ; hammered iron or steel bars or shapes, n.o.p., 30 per cent. ad valorem.

Iron or steel castings, in the rough, n.e.s., 25 per cent. ad valorem.

Stove plates, stoves of all kinds, for oil, gas, coal or wood, or parts thereof, and sad or smoothing, hatters' and tailors' irons, plated wholly or in part, or not, 25 per cent. ad valorem.

Spring axles, axle bars, n.e.s., and axle blanks, and parts thereof, of iron or steel, for railway or tramway, or other vehicles, 35 per cent. ad valorem.

Cart or wagon skeins or boxes, 30 per eent. ad valorem.

Cast iron pipe of every description, eight dollars per ton.

Wrought iron or steel boiler tubes, n.e.s., including flues and corrugated tubes for marine boilers, 5 per cent. ad valorem.

Tubes of rolled steel, seamless, not joined or welded, not more than one and one-half inch in diameter ; and seamless steel tubes for bicycles, 10 per cent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, over two inches in diameter, n.e.s., 15 per eent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, two inches or less in diameter, n.e.s., 35 per cent. ad valorem.

Other iron or steel pipe or tubing, plain or galvanized, riveted, corrugated or otherwise specially manufactured, n.o.p., 30 per cent. ad valorem.

Iron or steel fittings for iron or steel pipe, of every description, and chilled iron or steel rolls, 30 per cent. ad valorem.

Iron or steel cut-nails or spikes (ordinary builders') ; and railroad spikes, one-half of one cent per pound.

*The expression "gauge," when applied to metal sheets or plates or to wire, means the thickness as determined by Stubb's standard gauge ; the expression "in diameter," when applied to tubing, means the actual inside diameter; the expression "sheet," when applied to metals, means a sheet or plate not exceeding three-sixteenths of an inch in thickness; the expression "plate," when applied to metals, means a plate or sheet more than three-sixteenths of an inch in thickness

Wrought and pressed nails and spikes, trunk, clout, coopers', cigar box, Hungarian, horse-shoes, and other nails, n.e.s., horse, mule and ox shoes, 30 per cent. ad valorem.

Wire nails of all kinds, n.o.p., three-fifths of one cent per pound.

Composition nails and spikes and sheathing nails, 15 per cent. ad valorem.

Iron or steel shoe tacks, and ordinary cut tacks, leathered or not, brads, sprigs and shoe nails, double pointed tacks, and other tacks of iron and steel, n.o.p., 35 per cent. ad valorem.

Screws, commonly called "wood screws," of iron or steel, brass or other metals, including lag or coach screws, plated or not, and machine or other screws, n.o.p., 35 per cent. ad valorem.

Coil chain, coil chain links, and chain shackles, of iron or steel, five-sixteenths of an inch in diameter and over, 5 per cent. ad valorem.

Barbed wire, and galvanized wire for fencing, numbers nine, twelve and thirteen gauge, 15 per cent. ad valorem, until 1st January, 1898; thereafter free.

Buckthorn strip fencing, woven wire fencing, and wire fencing, of iron or steel, n.e.s., 15 per cent. ad valorem.

Wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered, n.e.s., 30 per cent. ad valorem.

Brass wire, plain, 10 per cent. ad valorem.

Copper wire, plain, tinned or plated, 15 per cent. ad valorem.

Wire cloth, or woven wire of brass or copper, 25 per cent. ad valorem.

Wire of all metals and kinds, n.o.p., 20 per cent. ad valorem.

Wire rope, stranded or twisted wire, clothes line, picture or other wire, and wire cable, n.e.s., 25 per cent. ad valorem.

Wire cloth or wove wire, and wire netting, of iron or steel, 30 per cent. ad valorem.

Needles, of any material or kind, and pins manufactured from wire of any metal, n.o.p., 30 per cent. ad valorem.

Lead, old, scrap, pig and block, 15 per cent. ad valorem.

Lead, in bars, and in sheets, 25 per cent. ad valorem.

Lead pipe, lead shot and lead bullets, 35 per cent. ad valorem.

Lead, manufactures of, n.op., 30 per cent. ad valorem.

Brass and copper nails, tacks, rivets and burrs or washers; bells and gongs, n.e.s., and all manufactures of brass or copper, n.o.p., 30 per cent. ad valorem.

Zinc, manufactures of, n.o.p., 25 per cent. ad valorem.

Nickel anodes, 10 per cent. ad valorem.

Iron or steel nuts, washers, rivets, and bolts, with or without threads, and nut, bolt and hinge blanks, and T and strap hinges of all kinds, n.e.s., three-quarters of one cent per pound and 25 per cent. ad valorem.

Builders', cabinet-makers', upholsterers', harness-makers', saddlers', and carriage hardware, including butt-hinges, locks, curry-combs or curry-cards, horse-boots, harness and saddlery, n.e.s., 30 per cent. ad valorem.

Skates of all kinds, roller or other, and parts thereof, 35 per cent. ad valorem.

Gas meters, 35 per cent. ad valorem.

Safes, doors for safes and vaults; scales, balances, weighing beams, and strength testing machines of all kinds, 30 per cent. ad valorem.

Carvers, knives and forks of steel, butcher and table steels, oyster, bread, kitchen, cooks', butcher, shoe, farrier, putty, hacking and glaziers' knives, cigar knives, spatulas or palette knives, razors, erasers or office knives, pen, pocket, pruning, sportsmen's or hunters' knives, manicure files, scissors, trimmers; barbers', tailors', and lamp shears, horse and toilet clippers, and all like cutlery, plated or not, n.o.p. When any of the above articles are imported in cases or cabinets, the cases or cabinets shall be dutiable at the same rate as their contents—30 per cent. ad valorem.

Knife blades or blanks, and table forks of iron or steel in the rough, not handled, filed, ground or otherwise manufactured, 10 per cent. ad valorem.

Celluloid, moulded into sizes for handles of knives and forks, not bored nor otherwise manufactured; also, moulded celluloid balls and cylinders, coated with tin-foil or not, but not finished or further manufactured, and celluloid lamp shade blanks, 10 per cent. ad valorem.

Bird, parrot, squirrel and rat cages, of wire, and metal parts thereof, 35 per cent. ad valorem.

Files and rasps, n.e.s., 30 per cent, ad valorem.

Adzes, cleavers, hatchets, saws, wedges, sledges, hammers, crow-bars, cant-dogs and track tools; picks, mattocks, and eyes or poles for the same; anvils, vises; and tools, of all kinds, for hand or for machine use, including shoemakers' and tinsmiths' tools or bench machines, n.o.p., 30 per cent ad valorem.

Axes, scythes, sickles or reaping hooks, hay or straw knives, edging knives, hoes, rakes, pronged forks, snaths, farm, road or field rollers, post-hole diggers, and other agricultural implements, n.e.s., 25 per cent. ad valorem.

Shovels and spades, iron or steel, n.e.s.; shovel and spade blanks, and iron or steel cut to shape for the same; and lawn mowers, 35 per cent. ad valorem.

Britannia metal, nickel silver, Nevada and German silver, manufactures of, not plated, and manufactures of aluminum, n.o.p. 25 per cent. ad valorem.

Sterling or other silverware, nickel-plated ware, gilt or electro-plated ware, wholly or in part, of all kinds, n.e.s., 30 per cent. ad valorem.

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds; and electric apparatus, n.e.s., 25 per cent. ad valorem.

Electric light carbons and carbon points, of all kinds, n.e.s., 35 per cent. ad valorem.

Carbons over six inches in circumference, 15 per cent. ad valorem.

Lamps, side-lights and head-lights, lanterns, chandeliers, gas, coal or other oil fixtures and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade-holders, 30 per cent. ad valorem.

Lamp springs, and glass bulbs for electric lights, 10 per cent. ad valorem.

Babbitt metal, type metal, phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire, 10 per cent. ad valorem.

Type for printing, including chases, quoins and slugs, of all kinds, 20 per cent. ad valorem.

Plates engraved on wood, steel, or other metal, and transfers taken from the same, including engravers' plates of steel, polished, engraved or for engraving thereupon, 20 per cent. ad valorem.

Stereotypes, electrotypes, and celluloids for almanacs, calendars, illustrated pamphlets, newspaper advertisements or engravings, and all other like work for commercial, trade or other purposes, n.e.s., and matrices or copper shells for the same, one and one-half cent. per square inch.

Stereotypes, electrotypes and celluloids of newspaper columns, and bases for the same, composed wholly or partially of metal or celluloid, one-fourth of one cent per square inch.

And matrices or copper shells for the same, one and one-half cents per square inch.

Clothes wringers for domestic use, and parts thereof, 35 per cent. ad valorem.

Buckles of iron, steel, brass or copper, of all kinds, n.o.p., (not being jewellery), 30 per cent. ad valorem.

Guns, rifles, including air guns and air rifles, not being toys, muskets, cannons, pistols, revolvers, or other firearms; cartridge cases, cartridges, primers, percussion caps, wads, or other ammunition, n.o.p.; bayonets, swords, fencing foils and masks; gun or pistol covers or cases, game bags, loading tools and cartridge belts, of any material, 30 per cent. ad valorem.

Agate, granite or enamelled iron or steel hollow-ware, 35 per cent. ad valorem.

Enamelled iron or steel ware, n.e.s.; iron or steel hollow-ware, plain black, tinned or coated; and nickel and aluminum kitchen or household hollow-ware, n.e.s., 30 per cent. ad valorem.

Tinware, plain, japanned, or lithographed, and all manufactures of tin, n.e.s., and manufactures of galvanized sheet iron or of galvanized sheet steel, n.o.p., 25 per cent. ad valorem.

Signs, of any material, framed or not; and letters of any material for signs or similar use, 30 per cent. ad valorem.

Fire engines and fire extinguishing machines, including sprinklers for fire protection, 35 per cent. ad valorem.

Brass pumps of all kinds, and garden or lawn sprinklers, 30 per cent. ad valorem.

Printing presses, printing machines, lithographic presses and type-making accessories therefor ; folding machines, book-binders' book-binding, ruling, embossing and paper cutting machines, and parts thereof, 10 per cent, ad valorem.

Sewing machines, and parts thereof, 30 per cent. ad valorem.

Steam engines, boilers, ore crushers and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, cranes, derricks, percussion coal cutters, pumps, n.e.s., windmills, horse-powers, portable engines, threshers, separators, fodder or feed cutters, potato diggers, grain crushers, fanning mills, hay tedders, farm wagons, slot machines and type-writers, and all machinery composed wholly or in part of iron or steel, n.o.p., 25 per cent. ad valorem.

Machine card clothing, 25 per cent. ad valorem.

Mould boards or shaves, or plough plates, land sides, and other plates for agricultural implements, when cut to shape from rolled plates of steel, but not moulded, punched, polished or otherwise manufactured, 5 per cent. ad valorem.

Mowing machines, harvesters, self-binding or without binders, binding attachments, reapers, cultivators, ploughs, harrows, horse-rakes, seed drills, manure spreaders, weeders, and malleable sprocket or link belting chain for binders, 20 per cent. ad valorem.

Trawls, trawling spoons, fly hooks, sinkers, swivels, and sportsmen's fishing bait, and fish hooks, n.e.s., 30 per cent. ad valorem.

Patterns of brass, steel, or other metals (not being models). 30 per cent. ad valorem.

Manufactures, articles or wares not specially enumerated or provided for, composed wholly or in part of iron or steel, and whether wholly or partly manufactured, 30 per cent. ad valorem.

VEHICLES.

Freight wagons, drays, sleighs, and similar vehicles, 25 per cent. ad valorem.

Buggies, carriages, pleasure carts and similar vehicles, n.e.s., including cutters, children's carriages and sleds, and finished parts thereof, n.o.p., 35 per cent. ad valorem.

Railway cars (or other cars), wheel-barrows, trucks, road or railway scrapers and hand-carts, 30 per cent. ad valorem.

Bicycles and tricycles, 30 per cent. ad valorem.

MINERALS.

Asbestos in any form other than crude, and all manufactures thereof, 25 per cent. ad valorem.

Plumbago, not ground or otherwise manufactured, 10 per cent. ad valorem.

Plumbago, ground, and manufactures of, n.e.s., and foundry facings of all kinds, 25 per cent. ad valorem.

SUNDRIES.

Ships and other vessels, built in any foreign country, whether steam or sailing vessels, on application for Canadian register, on the fair market value of the hull, rigging, machinery and all appurtenances ; on the hull, rigging and all appurtenances, except the machinery, 10 per cent. ad valorem ; on the boilers, steam engines and other machinery 25 per cent. ad valorem.

Canoes, skiffs, or open pleasure sail-boats, of any material, 25 per cent. ad valorem.

Canvas, and sail twine of hemp and flax, when to be used for boats' and ships' sails, 5 per cent. ad valorem.

Blasting and mining powder, two cents per pound.

Cannon, musket, rifle, gun and sporting powder and canister powder, three cents per pound.

Nitro-glycerine, giant powder, nitro and other explosives, three cents per pound.

Glycerine, when imported by manufacturers of explosives, for use in the manufacture thereof in their own factories, 10 per cent. ad valorem.

Torpedoes, firecrackers, and fireworks of all kinds, 25 per cent. ad valorem.

Fertilizers, compounded or manufactured, 10 per cent. ad valorem.

Photographic dry plates, 30 per cent. ad valorem.

Emery wheels, and manufactures of emery, 25 per cent. ad valorem.

Among the free goods are the following items :

Anchors for vessels.

Blast furnace slag.

Brass and copper, old and scrap, or in blocks ; and brass or copper in bolts, bars and rods in coil or otherwise, not less than six feet in length, manufactured, and brass or copper in strips, sheets or plates, not polished, plainshed or coated, and brass or copper tubing, in lengths of not less than six feet, and not polished, bent or otherwise manufactured, and copper in ingots or pigs.

Britannia metal in pigs, blocks or bars.

Burr-stones, in blocks, rough or unmanufactured, not bound up or prepared for binding into mill-stones.

Emery in bulk, crushed or ground.

Felt, adhesive, for sheathing vessels.

Fire bricks, for use in processes of manufacture, or for manufacturing purposes.

Hoop iron not exceeding 3-8 inch in width and being 25 gauge and thinner, used for the manufacture of tubular nuts.

Ingot moulds; iron, sand or globules, or iron shot and dry putty for polishing glass or granite

Iron or steel masts, or parts thereof, and iron or steel beams, angles, sheets, plates, knees, and cable chain for wooden, iron, steel or composite ships and vessels ; and iron, steel or brass manufactures which at the time of their importation are of a class or kind not manufactured in Canada, when imported for use in the construction or equipment of ships or vessels.

Locomotive and car wheel tires of steel in the rough.

Machinery imported exclusively for mining, smelting and reducing, viz.:—Coal cutting machines, except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore-drying machinery, ore-roasting machinery, electric or magnetic machines for separating or concentrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball and rock emery grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giant and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, gold mining slime tables, blast furnace blowing engines, wrought iron tubing, butt or lap welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining.

Nickel ; and ores of metal of all kinds ; and silex or crystallized quartz.

Rolled round wire rods in the coil, of iron or steel, not over three-eighths of an inch in diameter, when imported by wire manufacturers for use in making wire in the coil, in their own factories.

Scrap iron and scrap steel, old and fit only to be re-manufactured, being part of or recovered from any vessel wrecked in waters subject to the jurisdiction of Canada.

Silver, nickel and German, in ingots, blocks, bars, strips, sheets, or plates, unmanufactured.

Steel rails, weighing not less than 45 pounds per lineal yard, for use only in the tracks of a railway which is employed in the common carrying of goods and passengers, and is operated by steam motive power only ; provided that this item shall not extend to rails for tracks of a railway which is used for private purposes only, nor shall this item extend to rails for use in the tracks of any electric railway, street railway, or tramway.

Steel bowls for cream separators, and cream separators.

Steel saws and straw cutters cut to shape, but not further manufactured.

Crucible sheet steel, eleven to sixteen gauge, two and one-half to eighteen inches wide, for the manufacture of mower and reaper knives, when imported by the manufacturers thereof for use for such purpose in their own factories.

Steel of number twenty gauge and thinner, but not thinner than number thirty gauge, for the manufacture of corset steels, clock springs and shoe shanks, when imported by the manufacturers of such articles for exclusive use in the manufacture thereof in their own factories.

Flat steel wire, of number sixteen gauge or thinner, when imported by the manufacturers of crinoline or corset wire and dress stays, for use in the manufacture of such articles in their own factories.

Steel valued at two and one-half cents per pound and up-

wards, when imported by the manufacturers of skates, for use exclusively in the manufacture thereof in their own factories.

Steel, under one-half inch in diameter, or under one-half inch square, when imported by the manufacturers of cutlery, or of knobs, or of locks, for use exclusively in the manufacture of such articles in their own factories.

Steel of number twelve gauge and thinner, but not thinner than number thirty gauge, for the manufacture of buckle clasps, bed fasts, furniture casters, and ice creepers, when imported by the manufacturers of such articles, for use exclusively in the manufacture thereof in their own factories.

Steel of number twenty-four and seventeen gauge, in sheets sixty-three inches long, and from eighteen inches to thirty-two inches wide, when imported by the manufacturers of tubular bow sockets for use in the manufacture of such articles in their own factories.

Steel for the manufacture of bicycle chain, when imported by the manufacturers of bicycle chain for use in the manufacture thereof in their own factories.

Steel for the manufacture of files, augers, auger bits, hammers, axes, hatchets, scythes, reaping hooks, hoes, hand-rakes, hay-rakes, hay or straw knives, windmills and agricultural or harvesting forks when imported by the manufacturers of such or any of such articles for use exclusively in the manufacture thereof in their own factories.

Steel springs for the manufacture of surgical trusses, when imported by the manufacturers for use exclusively in the manufacture thereof in their own factories.

Flat spring steel, steel billets and steel axle bars, when imported by manufacturers of carriage springs and carriage axles for use exclusively in the manufacture of springs and axles for carriages or vehicles other than railway or tramway, in their own factories.

Spiral spring steel for spiral springs for railways, when imported by the manufacturers of railway springs for use exclusively in the manufacture of railway spiral springs in their own factories.

Steel strip and flat steel wire when imported into Canada by manufacturers of buckthorn and plain strip fencing, for use in the manufacture of such articles in their own factories; and barbed fencing wire of iron or steel after January 1st, 1898.

Galvanized iron or steel wire number nine, twelve, and thirteen gauge, after January 1st, 1898.

Stereotypes, electrotypes and celluloids of newspaper columns in any language other than French and English, and of books, and bases and matrices and copper shells for the same, whether composed wholly or in part of metal or celluloid.

Surgical and dental instruments (not being furniture) and surgical needles, after January 1st, 1898.

Tagging metal, plain, japanned, or coated, in coils, not over one and a half inch in width, when imported by manufacturers of shoe and corset laces for use in their factories.

Tin, in blocks, pigs, bars and sheets, tin plates, tin crystals, tin strip waste, and tin foil, tea lead.

Tubes, rolled iron not welded or joined, under one and one-half inch in diameter, angle iron, nine and ten gauge, not over one and one-half inch wide, iron tubing lacquered or brass covered, not over one and one-half inch in diameter, all of which are to be cut to lengths for the manufacture of bedsteads, and to be used for no other purpose, and brass trimmings for bedsteads, when imported by or for manufacturers of iron or brass bedsteads to be used for such purposes only in their own factories, until such time as any of the said articles are manufactured in Canada.

Wire, crucible cast steel.

Wire, rigging for ship and vessels.

Wire, of brass, zinc, iron or steel, screwed or twisted, or flattened or corrugated, for use in connection with nailing machines for the manufacture of boots and shoes, when imported by manufacturers of boots and shoes, to be used for such purposes only in their own factories.

Steel wire, Bessemer soft drawn spring, of numbers ten, twelve and thirteen gauge, respectively, and homo steel spring wire of numbers eleven and twelve gauge, respectively, when imported by manufacturers of wire matresses, to be used in their own factories in the manufacture of such articles.

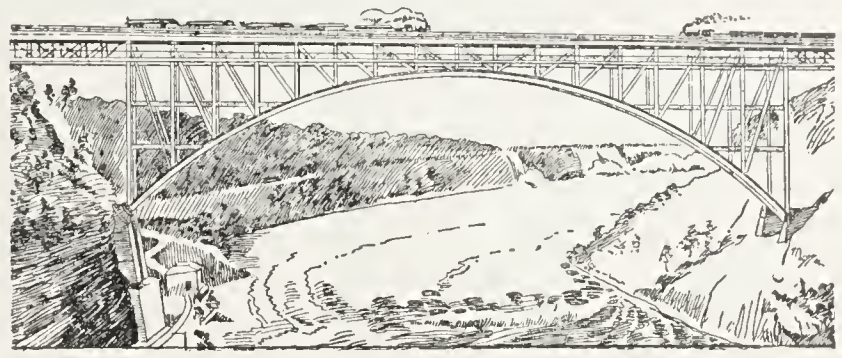
Yellow metal, in bolts, bars and for sheathing.

Zinc spelter and zinc in blocks, pigs, sheets and plates; seamless drawn tubing.

## THE NIAGARA ARCH BRIDGE.

The Niagara River is now spanned by three bridges, each of which was at the time of its erection a landmark in the engineering world, not only by reason of its vast proportions, but on account of those natural features which make the Niagara Gorge one of the world's wonders. These bridges represent distinct types of structure, the suspension, the cantilever, and the arch. The construction of an arch of such proportions never was attempted before.

The bridge which the arch has replaced was completed in 1855, the first train passing over it on March 8th of that year. Seven years were consumed in its construction. The original bridge had wooden trusses suspended on stone towers. In 1880 the suspended structure was changed to steel, and in 1886 the stone towers were replaced by towers of steel, both changes being made without any cessation of train



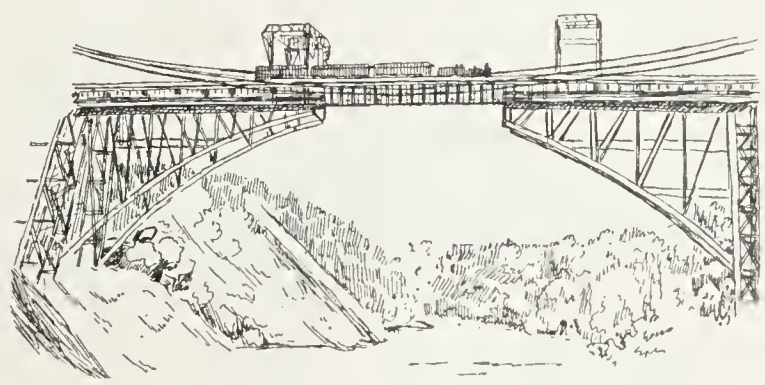
NEW NIAGARA ARCH BRIDGE.

traffic. The bridge had a span of 821 feet from centre to centre of the towers, and was suspended on four wire cables 10¼ inches in diameter, which carried a single track railway above and a carriage way on the lower deck. The engineer who designed and superintended the changes in the bridge was L. L. Buck, of New York, who also prepared the plans for the new structure.

The new arch has a span of 550 feet between the end piers, and a trussed span at each end 115 feet long connects the arch with the bluff The total length of the bridge with its approaches is 1,100 feet, and the centre of the arch 226 feet above the water. The steel ribs or main arches are four feet deep and three feet wide.

The bridge has two floors. On the upper floor there are two railway tracks, and on the lower floor a central carriageway, a double trolley track and sidewalks on each side. The width on top is 30 feet. The lower floor is 57 feet wide. The arch will support on each upper track at the same time two locomotives of the heaviest kind, followed by trains weighing 3,500 pounds to the square foot of bridge, and in addition a load of 3,000 per square foot on the lower floor. Seven million pounds of steel have been used in the building of this wonderful arch.

On the United States side of the river the bed plates of the arch rest on masonry built on the limestone rock, but on the Canadian side it was found necessary to build a foundation of concrete on which the masonry rests. The abutments are built about half way up the slope on each side. The stone for the abutment on the Canadian side was



NEW NIAGARA ARCH BRIDGE—UNDER CONSTRUCTION.

brought from the Queenston quarries. The bridge end of the shore span is hinged to the arch, and the shore end rests on expansion rollers on heavy masonry abutments. During construction the arch was supported as it was built out by a chain of vast strength made fast to a huge anchor sunk in solid masonry.

The test of the bridge was made July 29th, and R. S. Buck, the engineer in charge, said that "the test was very satisfactory in every respect. The weight which was placed on the bridge was about 2,600 tons, and is in excess of any that the bridge will be required to stand. The deflection was about an inch, which shows that the bridge is one of the strongest of its kind ever constructed. The test was in every way satisfactory to the bridge companies, the engineers, the Grand Trunk Railway, and the Pennsylvania Steel Company." This was endorsed by L. L. Buck, the designing and chief engineer. Among the officials present at the test were: Joseph Hobson, Montreal, chief

engineer of the Grand Trunk Railway; George L. Burrows, Saginaw, Mich., president of the Niagara Falls International Bridge Company; T. R. Merritt, St. Catharines, president, secretary and treasurer of the Niagara Falls Suspension Bridge Company, of Canada, these two companies being owners of the new bridge; L. L. Buck, of New York, the designing engineer, who had charge of the test; R. S. Buck, resident engineer, who supervised the construction of the bridge; J. B. Frame, Harrisburg, Pa., superintendent of the Pennsylvania Steel Company; Thomas R. Reynolds, the superintendent of the bridge companies; and Ross Mackenzie, Toronto.

The formal opening of the bridge will not take place for a month or so, when it is hoped that Sir Charles Rivers Wilson, president of the G.T.R., will be able to be present.

## BRITISH YUKON MINING REGIONS.

A SKETCH OF THE GREAT CANADIAN ELDORADO OF THE NORTH.

Although the fabulous finds of gold in the placer diggings of the streams and rivers tributary to the Canadian Yukon have only now begun to send a wave of excitement over the civilized world, the existence of rich gold finds there is not a discovery of to-day. For sixteen years or more gold has been mined along the Yukon and its tributaries, and, while the principal mining camps in the early days were in the American territory of Alaska, as long ago as 1887 we have official reports of extensive placer mines on the Canadian side, in which even then 300 miners were at work. The first official investigation of that region was undertaken by direction of the late Hon. Thos. White, then Minister of the Interior, who sent an exploring expedition, under Dr. G. M. Dawson and Wm. Ogilvie, the former one of the ablest geologists, and the latter one of the most skilful and courageous surveyors ever employed by the Dominion Government, and the value of whose technical skill is heightened so much by modesty and integrity.

Their explorations laid a healthy foundation for the developments which have since taken place in the Canadian Yukon region. As long ago as 1840 Campbell was commissioned by Sir George Simpson, of the Hudson Bay Co., to explore the Upper Liard. He traversed a part of the Pelly River Valley, and seven years later Fort Yukon, at the mouth of the Porcupine River, was established by the Hudson Bay Co., under A. H. Murray. In 1848 Campbell erected Fort Selkirk, which, however, was plundered by the Indians in 1852, and is now in ruins. In 1869 the Hudson Bay officers were expelled from Fort Yukon, which was found to be in American territory, and moved their trading post to Kampart House, but in 1890 it was found that this also was a few miles within the United States territory, and they were compelled to shift twenty miles up the Porcupine River. For many years, dating from 1873, private trading was carried on, chiefly by two traders named Harper and McQuestion, who had a partnership for some years. Harper is now at Fort Selkirk, and McQuestion is employed by the Alaska Commercial Co., at Circle City. For some years the trading by corporations in Alaskan territory has been largely a monopoly possessed by the Alaska Commercial Co., who may be called the Hudson Bay Company of the U.S. But in 1892 a Chicago corporation, known as the North American Transportation and Trading Company, started a line of steamers trading to Alaska. From dealing in furs and other northern produce, these and private corporations have become large carriers of passengers and freight for the mining regions. And so rapidly have developments taken place that transportation by rail from British Columbia and the North-West Territories, and even from Ontario via Hudson Bay, west across the McKenzie basin to Yukon, are now problems that require early solution in the handling of traffic.

FORTY MILE CAMP.—FROM A PHOTOGRAPH.

In 1894 the Canadian Mounted Police appeared on the scene of the placer diggings of the Upper Yukon, and established a post at Fort Cudahy, at the confluence of the Forty Mile Creek and Yukon River, under Inspectors Constantine and Strickland. By this date it was estimated that one thousand men were employed in mining there, and that the miners had taken out $300,000 from the Forty Mile Creek. At that time it appeared that the finds were chiefly in streams having their sources in United States territory, but as prospecting proceeded farther up the Yukon and tributary streams it was found that still richer diggings were found in the beds of rivers and streams wholly within Canadian territory. The inspectors estimated that there were 1,400 miles of streams in this district, in all of which gold could be found in paying quantities, and an old Swedish miner, who had been in California and British Columbia in the days of placer digging, said to one of the Government officials: "I never saw a country where there was so much gold, and so evenly distributed." This remark was made in 1887. One stream after another was prospected, and

FRONT OF NORTH-WEST MOUNTED POLICE POST—"WOOD-FATIGUE" DAY—WINTER SCENE—YUKON.

as fresh miners came in the area of discovery widened till creeks and streams almost by the score could be mapped out. When the enormous finds on the Klondike and Eldorado Creek became noised abroad these streams, nearly all of which would yield a good return for the miners' labor, were deserted until Dawson City, the centre of distribution of supplies for the Klondike, was estimated to have a population of from three to four thousand miners at the beginning of this year.

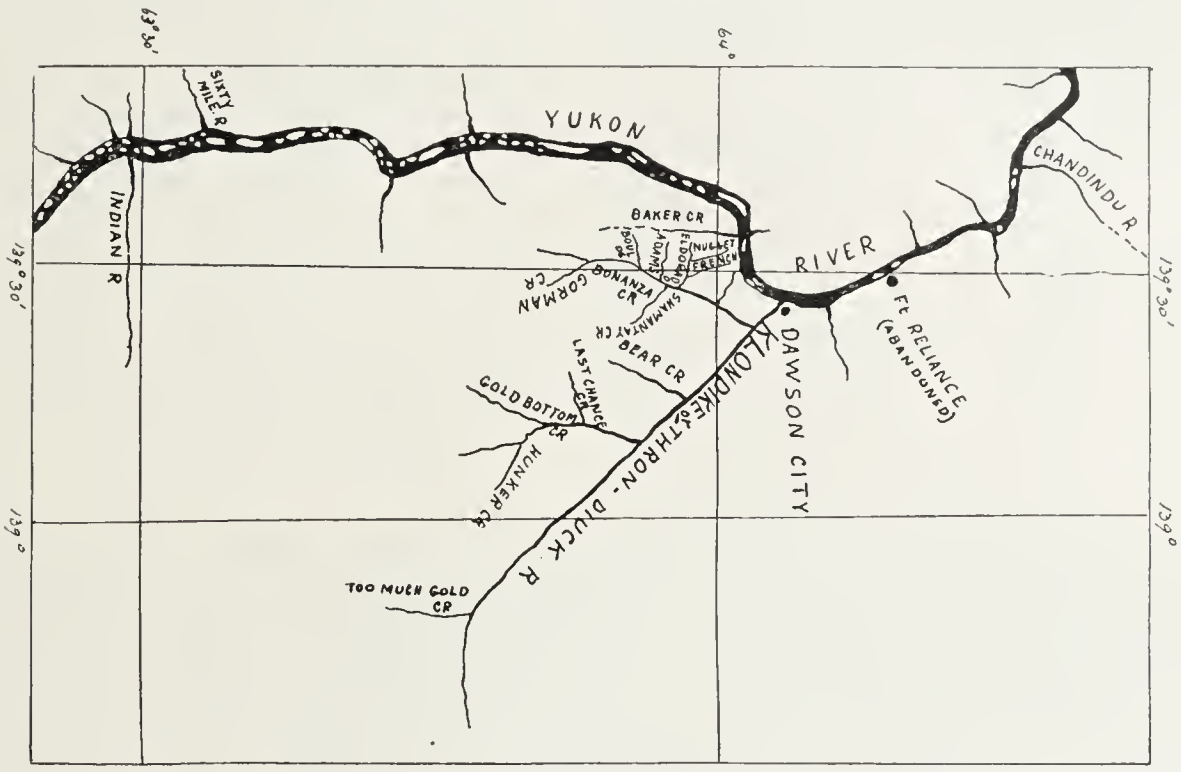
No doubt many of the stories of big finds are exaggerated, but we have before us a variety of evidence sufficient to show that, making due allowance for these exaggerations, the placer gold mines of the Klondike and other streams of the Canadian Yukon are the richest ever discovered in the world, and if this unprecedented richness exists in these alluvial deposits the quartz rock from which these golden grains have been washed must be equally unprecedented. The sources from which these river washings have come have naturally not yet attracted the miners in this inhospitable clime. For while such astonishing results can be obtained by simply washing the river sand with primitive appliances, they have not seen the necessity of attempting to bring up machinery for quartz mining, where transportation and living are so enormously high.

It should be mentioned, however, that the official reports of Dr. Dawson and Mr. Ogilvie show the existence of at least the beginnings of these gold-bearing quartz beds. In June, 1896, they found samples of quartz in a hill called Cone Hill, in the valley of the Forty Mile River, which assayed better than the celebrated Treadwell mine on the coast of Alaska, and the whole hill appeared to contain gold. A ledge of quartz was afterwards discovered on Twelve Mile Creek (the Chandindu), which appeared to be richer even than that of Cone Hill.

The question next in importance to that of the gold itself is the amount and convenience of fuel supply, and it seems a providential combination of the bounties of nature that the coal seams have been discovered which show beyond question that extensive mines of coal exist in the very midst of this wonderful gold mining tract. In fact the Canadian Yukon is another Transvaal, only on a still vaster scale. In the Transvaal the large deposits of coal that were found within convenient distance by rail of the Witwaters Rand field made that country what it is to-day. In 1887 Johannesburg was a Boer farm. Now it is a city of over 70,000 inhabitants, and the mines are equipped with the most scientific machinery known in the history of mining. The climate of the Yukon district may prevent its development from running on parallel lines with the

Transvaal, but there seems to be but little doubt that it will be the source of even greater wealth. Coal has been found on the Lewes River, above Five Finger Rapids. On Coal Creek, five miles below Forty Mile Creek, it has been discovered in ledges five to seven feet thick, and on Twelve Mile Creek there are also extensive deposits, as well as on the Chandindu River.

The Klondike is variously recorded on maps and charts as Thron-diuck, Throndik, Chandik, Tondak, Klondik, and Klondike. The first spelling is considered by Mr. Ogilvie to be the correct one. One authority gives "plenty of fish" as the meaning of the word, and another gives "reindeer," and it is put on some charts as the Deer or Reindeer River. The word Klondike seems likely, however, to come into general use.




In January, this year, still further deposits of coal were found in the upper reaches of the Klondike. It appears to be nearly all lignite coal of a good quality, and at the present date there appears to be little doubt that the quantity is sufficient to supply cheap fuel for a large population, not only for manufacturing and mining, but for domestic use.

The other minerals discovered and reported on officially are galena, in combination with gold, asbestos and copper, specimens of native copper having been brought in by Indians during the past year. What other minerals may be found only time and the perseverance of the prospectors in those regions can determine.

It would be impossible to give a correct estimate of the amount of gold already taken out of the Klondike. The table made of the finds made by miners returning on a single small steamer, the "P. W. Weare," showed that eight of these passengers brought down a total of $460,000, and other passengers had amounts varying from $10,000 to $30,000. Some of these passengers, however, refused to disclose the amount of their finds. The captain of another steamer, the "Portland," estimated the amount of gold brought down on his ship at $1,000,000. These and other boats returned from Alaska all within the month of July, and the total amount brought down this season has been calculated at from $2,000,000 to $5,000,000. It is on record that

one man obtained from one pan of dirt $204, from another $212, and from a third $216, these being the three biggest pans authentically reported. Two miners working on claims of their own cleaned up $6,000 from a single day's washing. In Bonanza Creek pans have varied from $1 to $12 per pan, but this means from $1,000 to $12,000 per day by sluicing. Mr. Ogilvie estimates the average in that creek at $5 to $7 per pan, and as this bed is 30 feet deep and 500 feet long, this means at the lower calculation, $4,000,000 in one creek. Mr. Ogilvie says there are here at least 15 miles of rich dirt.

Assuming corresponding riches in the other streams, a faint idea may be gathered of the value of gold stored in this part of Canada.

This wealth, almost surpassing any story in the world's library of fiction, is not to be got without effort, and it would be unwise to conceal the difficulties or to underestimate the self-sacrifice required of adventurers in these parts. The winter lasts nearly nine months of the year, and in midwinter during the last two years Mr. Ogilvie has recorded temperatures as low as 68 deg. below zero. In the Canadian territory, however, the atmosphere is dry by reason of its inland situation, and the winters are more tolerable here than along the other grasses can be introduced and acclimatized. Mr. Ogilvie estimates that there are about 360 square miles of arable land in the region he explored, but a good deal of this is not rich. It is therefore hardly likely that the farm lands of this region can do more than supplement the importations of food stuffs that would have to be brought from Eastern Canada. But given plenty of gold, railway transportation will in the future carry comfort to the inhabitants of the Yukon to the great advantage of every other part of Canada. While the products of the soil are a question of the future, miners can count on a considerable amount of fish and wild game. Cariboo are to be found on the uplands, and though moose have been killed off from the immediate vicinity of the miners, they are more plentiful in the inland districts. The grizzly, brown, black and silver-tipped bears are more or less plentiful, though not to be had without a spice of danger. The Arctic bear, which mysteriously swarms in countless numbers every seven years, and then, after two or three years, as mysteriously disappears, is a welcome source of food in its plentiful years. The mountain sheep and mountain goat, similar to those in British Columbia, are plentiful in the mountains. Of fur-bearing game there is the grey, black, and red foxes, the marten, the lynx and a few

FORTY MILE TOWN.

American coast in the same latitudes. By dressing warmly in closely-woven woolen garments (but preferably in fur garments, after the Laplander style), many miners pass the winter in tolerable comfort, if not in positive enjoyment. While in the short summer the thermometer sometimes dips to the freezing point, or even below, the temperature frequently runs up to 100 deg. in the shade. This may seem surprising to inhabitants of lower province latitudes, but it must be remembered that in the latitude of between 60 and 65 (in which is enclosed the rivers and streams under present consideration), there is continuous daylight from the middle of June to the middle of August, and even longer as you approach the Arctic circle. The illustrations shown in connection with this sketch, taken as they are from photographs, show a greater profusion of vegetation than one would expect, and it is a fact that vegetables such as onions and turnips have been grown within the last two or three years, and no doubt other vegetables and plants can be grown when the peculiarities of the climate are better understood. Two or three kinds of native grasses, which afford food for cattle, are to be found in some of the numerous valleys extending along these rivers ; and doubtless otter. Bird life is not so plentiful. The white-headed eagle, the raven, the magpie, the ptarmigan, wild geese and ducks, loons, and a bird like our Eastern chicadee, but larger, are the principal wild birds. Of these the ptarmigan, geese and ducks are the most plentiful. The fish of the rivers and small lakes are the salmon and lake trout, and a species of Arctic trout.

The timber of this district is chiefly poplar, spruce and pine. It is of a stunted growth in the neighborhood of the present mining camp, but in other parts grows very well. Even along some of the mining streams poplar is found eight or ten inches in diameter, especially round Lake Labarge.

There are two main routes at present to the Yukon. One is from the mouth of the Yukon, in American territory, up the Yukon to its tributaries. Another is by the Lynn channel, from which three different passages lead to the mines—the Chilcoot and the Taiya mountain passes, and another is by the same channel, through an easier pass, called the White Pass, and named after the late Hon. Thomas White. The old Yukon route is the longest, and, as the river is swift and has many windings and is open for navigation only about three months in the year, it is manifest that a railway from British Columbia

or by Hudson Bay, across the continent, must be the route of the near future. Mr. Ogilvie estimates the rate of discharge of the Yukon River at about 300,000 cubic feet of water per second. This is about one-third of the discharge of the St. Lawrence, but greater than the discharge of the Mississippi, and four times that of the Ottawa. The Yukon is navigable for about 2,300 miles, but in many places is shallow, and has to be navigated by flat-bottomed boats, especially built for this work. A new fleet of 10 or 15 of these boats is now being built by the British Yukon Company for service on the Canadian Yukon, connecting the mining camps with the different mountain passes over British Columbia, a distance of 620 miles. Some will also ply on the lower Yukon. The miner is aided over these passes by dog-sleds and the uncertain help of Indians. But appliances are now being brought in to surmount the most difficult parts, and the next improvement will be the railway. Already the British Yukon Company contemplate a narrow-gauge railway over the White Pass, during the coming spring, and the C.P.R. contemplates making a connection with the Yukon from Edmonton. A line of about 50 miles from Edmonton would reach Athabasca Landing, from which a water route would be open via Athabasca River and Lake, Great Slave Lake and River, and the McKenzie River, to Port McPherson. This would make the distance from Edmonton to Port McPherson (which is quite near to the Klondike divide) 1,800 miles, as against a total of 4,300 miles from Seattle to the mouth of the Yukon, and up that river through American territory. A rail route by the White Pass presents fewer engineering difficulties than was at first imagined, and it would be available all the year round, as against three months by the Yukon route. An American and Canadian Customs port of entry has been established at Dyea, within Canadian territory, and this step may be accepted as an admission of the independence of the Lynn Channel route. The question of the main boundary along the British Columbia coast being yet undefined, the Dominion Government is taking steps to conserve the public interests by regulations providing for the reservation of alternate claims, and for the payment of royalties on the claims already allotted. But judging by the reports of the influx of miners from all quarters, it would be well for the Government to increase the detachment of the Mounted Police sent up to maintain order, this detachment at present numbering 80.

Meantime only active, healthy men should undertake this journey, and ample provision should be made in the way of supplies and food.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain for June, 1896 and 1897, and the six months ending June, 1896 and 1897 :

| | Month of June, | | Six months ending June, | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £4,618 | £6,283 | £32,111 | £31,930 |
| Pig iron | 2,086 | 1,847 | 9,866 | 2,865 |
| Bar, etc. | 2,202 | 808 | 8,501 | 5,013 |
| Railroad | 25 437 | —— | 47,475 | 20,286 |
| Hoops, sheets, etc | 4,446 | 6,245 | 16,142 | 22,690 |
| Galvanized sheets | 7,682 | 3,377 | 23,854 | 19,375 |
| Tin plates | 11 435 | 7,981 | 67,554 | 88,953 |
| Cast, wrought, etc., iron | 4,535 | 2,369 | 26,103 | 17,334 |
| Old (for re-manufacture) | 5,865 | 925 | 8,926 | 1,497 |
| Steel | 7,680 | 4,958 | 44,407 | 23,433 |
| Lead | 2,113 | 2,806 | 7,556 | 7,26$_0$ |
| Tin, unwrought | 640 | 909 | 7 714 | 9,83$_4$ |

JUNCTION OF FORTY MILE CREEK AND YUKON RIVER. (RIGHT HAND VIEW.)

—Commenting on the treatment which the city engineer of Toronto, E. H. Keating, receives at the hands of the city council, the Toronto *Evening News* says in a recent editorial : "The attack upon the Engineer's department, by the aldermen, is not a new thing in the City of Toronto. As far back as the memory of the oldest inhabitant can go, the Engineer has been treated as good game for designing members of the council to go after when they think their interests demand an exhibition of economy. It is so easy for a contractor like Ald. Gowanlock to criticise an official, and it is such a popular proceeding with a certain section of the electorate, that there need be little wonder at the frequency of the attacks. The same applies to other aldermen. It was not otherwise twenty-five years ago, when Walter Shanly was city engineer. The interference and senseless criticism of the aldermen drove him out of the city's employ. He told his committee candidly that he would not be directed by a parcel of ignorant men as to how he should carry out his work, and sent in his resignation. Mr. Jennings' experience was almost identical with that of Mr. Shanly. He refused to accept the dictation of men who knew no more about engineering than a monkey does about algebra, and the consequence was he had to resign. The aldermen of the City of Toronto worried Charles Sproatt into his grave. They loaded him with work that would have kept four men busy, and when anything went wrong he was made the scapegoat for the meddling members who were to blame."

## CORRECTIONS.

In the account of the manufacture of carborundum which appeared in last issue, "sugar" was given as one of the ingredients. It should have been "coke." A slight error also appeared in the description of the London and North-Western Railway, in which the distance between London and Liverpool was given as 100¾ miles. It should have been 200¾ miles.

## FIRES OF THE MONTH.

July 16th.—Royal Pulp and Paper Company's new mill, pulp mill and blacksmith's shop, East Angus, Que. Loss, $150,000.—July 13th—Anderson's planing mill, Sudbury, Ont. Loss, $7,500.—July 19th—The McKay Milling Company's flour mill, Ottawa, Ont., damaged to the amount of $17,000.—July 22—C. F. Langevin & Co.'s saw mill, grist mill and woolen mill, Acton Vale, Que. Total loss.—July 25—T. Bunn's foundry machine shop, Cayuga, Ont. Loss, $2,000.—July 25th—J. Henley's saw mill, St. Gabriel, Que. Totol loss.—July 25th—Toronto Brass Co., Toronto; damage amounting to $2.500.—July 25th—Eastern Abattoir, Montreal. Loss, $100,000.—July 27th—C.P.R. car shops at Carleton Place, Ont.; damages amounted to $2,000.—July 28th—Standard Oil Co.'s warehouse, Winnipeg. Loss, $25,000.

# Mining Matters.

THE Echo Mining Company, in Slocan, will build a tramway to Sandon, and erect concentrators.

AN inventor has recently communicated to the Ontario Bureau of Mines a new method of reducing nickel ores without roasting them. The department will investigate this process.

THE Lucky Jim Gold Mining Co., Sandon, B.C., has ordered from the Jenckes Machine Co., Sherbrooke, Que., through its Rossland branch, the iron work for one three-wheel tramway.

THE Citizens' Coal Co., Sudbury, Ont., has decided to get machinery to sink a shaft. At 80 feet they struck four feet of mineral. Furnace tests are said to show good burning qualities.

PROF. GOODWIN, of the Kingston School of Mines, has recently set up an exhibit of minerals, at Rat Portage, Ont., which will be of much interest and value to everyone there interested in mineral development.

THE Colonna Gold Mining Co., Rossland, B.C., is putting in an air pipe line to connect its two properties. This has been bought through the Rossland branch of the Jenckes Machine Company, Sherbrooke, Que.

THE Dardanelles Mining Co , at Kalso, B.C., has placed an order with the Rossland, B.C., branch of the Jenckes Machine Co., of Sherbrooke, Que., for a complete mining plant for operating its properties in that district.

ALEXANDER McCOY, Sault Ste. Marie, Ont., has discovered gold in the vicinity of Michipicotten river, north of the famous island of Michipicotten, where considerable mining for copper was done by H R. Fletcher fifty-two years ago.

A CHARTER has been granted to Hon. Geo. Cox, Wm. Mackenzie, G. H. Bertram, J. S. Playfair, A. Horton, A. Cox, A. Angstrom, M.E.; S. C. Smoke and J. H. Bertram, Toronto, as the Mines Investment Association of Ontario, Ltd., to do a general mining business.

THE erection of the Fraser & Chalmers' mill at the Saw Bill mine was done under the direction of S. B. Schrontz, one of Fraser & Chalmers' men, who has, it is said, superintended the construction of some of the biggest plants on the continent.

THE gold excitement on the Saskatchewan river, N.W.T., still continues. This spring a large number of new dredges were constructed, and several work at night by electric light. Claims are staked out along both sides of the river for a distance of a hundred miles.

THE Elgin Field Oil and Gas Company, who have been boring for oil and gas in Dunwich township, near Tyrconnell, Ont., have struck an immense flow of gas at a depth of 130 feet. The gas was found in a twenty-foot bed of gravel just above the rock, and there was no water with the gas.

THE Philadelphia capitalists, Stevenson & Son, who own the Highlander mine at Ainsworth, B.C., have arrived with the machinery for putting in the tramway and concentrator. The tram will run from the Highlander to the lake, and it is expected that the concentrator will be running by the end of August.

THE Jenckes Machine Co., Sherbrooke, Que., shipped to the American Asbestic Co., Danville, Que., recently, one of their 20-drill air compressors, together with three high speed crushing rolls and two picking tables, being a plant required by the Asbestic Co. in connection with the extension of its operations.

THE calcining and refining furnaces of the Hall Mines smelter at Nelson, B.C., not long ago turned out the first copper produced in British Columbia. It carries 97 per cent. of copper, silver and gold, which is as fine as it can be made in furnaces of this nature. The value carried to the ton is $530, including about $50 in gold.

THE Jenckes Machine Co., Sherbrooke, Que., has just completed for the Sultana mine at Rat Portage, Ont., one 30-stamp mill, with six vanners, one 150 h.p. Corliss engine, with complete equipment of boilers, compressor and hoisting plant. This is said to be the largest and most complete plant of this kind in the Lake of the Woods district.

THE Ibex mine has let a contract for packing 500 tons of ore. Foss & MacDonnell have a contract to build a tramway, which will be 6,000 feet long. Fifty men are now at work on it, and will have it completed by October. The Canadian Pacific Railway surveyors are locating a wagon road from Three Forks to McGuigan and Bear Lake, a distance of five to six miles.

THE Hiawatha mine is on Clear Water Lake in the Saw Bill country, and it has four veins from 2 to 8 feet wide, and assaying from $7 to $17 to the ton in gold. Vein No. 1 has been uncovered for 116 feet, No. 2 for 400, No. 3 for 630 and No. 4 for 250 feet. Seven test pits from 6 to 15 feet in depth have been sunk with, it is said, encouraging results, and a shaft is being put down on vein No. 2.

THE directors of the Calumet and Hecla Mining Company paid an "extra" dividend of $5 per share, July 7th, to stockholders of record June 11th. The last previous dividend was $5, and was paid April 23rd. The total payments thus far this calendar year have been $30 per share, as against $25 for the corresponding period last year. The two declarations call for $1,000,000, and bring the company's aggregate dividend disbursements up to $49,850,000.

THE Commander Mining and Smelting Co. wrote to the Canadian Rand Drill Co., Sherbrooke, Que., a short time ago as follows: "Gentlemen—We have run 570 feet, 5 x 7 foot tunnel, in the hard rock of this camp in the past 7 months, with one of your 2⅛ Seuggar drills and compressors, at an expense for duplicate parts and repairs on the above drill of only $4.65, which expense includes two throttle handles and rubber buffers. Yours truly, J. HOUGHTON, Supt. Commander Mining and Smelting Co."

WE are in receipt of the Directory of Mines for May, 1897, published by the *Mining Record*, Victoria, B.C. The book contains a complete synopsis of the mining laws of British Columbia, with amendments passed at the late session of the legislature, compiled by Archer Martin, barrister-at-law, Victoria, B.C. In addition to the above, much useful information relating to the mines and mining generally is included. Those wishing to know the state of the mining laws as they stand to-day should procure a copy of the work.

PETROLEUM has long been known to exist in the Gaspe peninsula of Quebec, and several years ago a company known as the Petroleum Oil Trust was formed to search. Oil of a light green shade, of fine quality, like that of Pennsylvania, was found in several places, but not in paying quantities. At last, after several years and much money spent in prospecting, oil has been struck in lot 40 in the township of Galt. The day after the strike was made (22nd of July) a ten barrel tank was made and filled in two and a half minutes, or at the rate of over 5,000 barrels a day. There is great excitement among the people in the parishes of Galt and Baillairge.

NOVA SCOTIA gold mining shows much activity and bright prospects. About the middle of last month, Dr. John H. McKay and Geo. W. Stuart returned from Sherbrooke, Goldenville and Wine Harbor, and reported developments on the Napier property at Wine Harbor most encouraging. A trial lot of rock from one lead gave 17 dwt. per ton. Goldenville is now a busy mining camp, besides the Bluenose and New Glasgow Co.'s producing regularly their large bricks. Geo. Hirschfield has recently leased from Mr. Stuart a small area, from which he took, for the month of June, 228 ounces of gold, netting him a profit of $3,000.

W. G. MILLER, professor of geology at the Kingston School of Mining, is now employed by the Government in making a geological exploration of the eastern counties of the province, doing for that section practically the same work that Dr. Coleman is doing in the west. The special service in which he is engaged is the examination of known deposits of corundum, with a view to studying the geological relations of this valuable mineral. He will also explore for gold and other ores, and will send in a report of his work to the Bureau of Mines. The

counties over which his investigations will range are Peterborough, Hastings, Addington, and Frontenac, particularly in the northern portions, which are mineral-bearing.

THE Le Roi Company paid two dividends of $25,000 each, in July, making $475,000 paid in dividends by the company. To the disappointment of British Columbia people, the company has located its smelter at Northport, on the American side. A correspondent says the "purchase of the Pilot Bay smelter, by the Grant and Omaha Company, is confirmed, and is regarded as a proof that had the Le Roi people really desired to locate their reduction works in Canada, they could have done so with advantage in the end. The various statements made by the company, from time to time, are regarded as so many pretexts to avoid the export duty later on. The precedent is not likely to be followed."

AN important syndicate in London, England, has acquired 108,000 acres of mining lands on the north shore of Lake Superior, including the Silver Islet mine, and has begun exploratory work, with a view to testing the value of the property. The Silver Islet Mining Company has for a number of years past owned some very extensive properties on the north shore of Lake Superior, comprising 108,000 acres, which extend from Pigeon River to the "Soo." These lands, amongst which was the celebrated Silver Islet mine, were obtained from the Montreal Mining Company, which latter had conducted exploratory work on them about the year 1885-6. When operations on Silver Islet mine suspended, silver to the value of over $3 000,000 had been taken out of the mine.

A DISCOVERY of fabulously rich milling ore has been reported on the northern shore of the Gulf of Georgia, B.C., 140 miles from Vancouver. Every piece of rock taken out of the vein, which is said to be ten feet wide, is ribbed around with coarse gold, which assays many thousands of dollars to the ton, and the specimens are far richer than any before seen in the province. Like all other rich strikes, this was found by accident. Hundreds of prospectors have scoured the country and the one who made the strike had given up the search. He was digging a trench around his tent when he struck the gold seamed rock. He was found a week later raving mad; the excitement caused by the rich find had turned his head, and the only words he could say were: "I have found it." Very rich free milling finds have also been made in Lillooet and Soquansht.

THE report of the Dominion Coal Company, N.S., for the year ending February 28th, 1897, shows that the net proceeds from coal mined were $303,038 and transportation profits $286,263, a total of $589,301. The payments were:—General expenses, $80,548; interest and sinking funds, $267,937; dividends, $166,667; total, $515,152. This leaves a surplus of $74,149, which added to the balance of $18,-214 brought forward from the previous year, leaves a surplus of $92,-362 carried forward to the current year. President Whitney's report says: "The output for 1896 was 1,169,785 tons. This is larger by 284,881 tons than for the previous year. During the latter part of the year it was found desirable to erect a coal-washing plant. This was proceeded with, and is now in operation. It has proved economical and effective in increasing the market value of the smaller grades of coal. The satisfactory results of last year's work were due largely to our increased output and saving in cost of mining and transporting the coal."

B. E. WALKER, general manager of the Bank of Commerce, said in a recent speech to the directors of the bank: "It is well to remember that if mining pays fair wages to those engaged in it, and a fair dividend on the capital employed, that is all we have the right to expect. The world is full of men looking for only fair wages and of capitalists seeking only a fair dividend. It is also well to remember that mining is a business requiring large capital, and apt to absorb the first earnings as a further investment of capital before settling down to the payment of steady dividends. It also requires, like any other manufacturing venture, absolute knowledge of the business in all its details, if success is to be confidently relied on. But like other manufacturing ventures, if skill and capital are properly applied, the result will, in the majority of cases, justify the venture. We hope, however, it will not be taken amiss if we compare this kind of mining with much that is going on in Canada at the present. Many of the ventures offered to the public do not seem to be backed up by skill in the particular business of mining and adequate capital, and in such ventures hundreds of people are risking sums, not large in themselves, perhaps, but of great consequence to the owners, who in the majority of cases we fear must lose. No one really interested in the great future which mining doubtless has in Canada, will, we think, dispute the wisdom of such a note of warning at the present time."

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WM. BUCK, the well known stove manufacturer, of Brantford, Ont., died very suddenly from heart disease, while attending a performance of the Wild West Show recently.

# Railway Matters.

MONCTON'S (N.B.) new railway station is to be buffed brick with stone trimmings.

EXTENSIVE changes are being made in the C. P. R. shops, Granby, Que., for the purpose of manufacturing cars.

T. PEGNEM, a sub-contractor for Foley Bros., on the Crow's Nest Pass Railway, took a number of laborers out from Montreal.

PREMIER GREENWAY states that he expects to complete the contract for the construction of the Winnipeg-Duluth Air line before the end of August.

FOLEY Bros., of St. Cloud, Minn., formerly of Almonte, Ont., have the contract for constructing 34 miles of the Crow's Nest Pass Railway from Lethbridge.

THE minister of railways has given notice to the C. P. R. that the arrangement by which it uses the Intercolonial from St. John, N B., to Halifax, N.S., will terminate in a year.

THE South-Eastern Valley Railway Company having obtained leave from the Federal Government to cross the Vermont Central Railway line near Ibervillle, Que., will commence their work of construction.

THE erection of the new east end (Dalhouise Square) station and hotel of the C.P.R. in Montreal is going on rapidly, and the contractors are ahead of their time. The station will have eight tracks for passenger trains and four for baggage and express work.

THE steamer "Coban" is taking a load of material for the bridges on the Newfoundland Railway, which is now nearing completion. As soon as the road is finished the steamer "Jubilee" will make regular trips from the western terminus of the railway to Sydney, N.S. The "Jubilee" is soon expected out from Scotland.

THE Grand Trunk Railway work shops in Toronto are being removed to London. In future the repairing of all heavy cars will be done in the Forest City. There have been 120 men employed at the shops in Toronto; 100 of these will be sent to London, while the others will remain in Toronto to do small repairs.

MACKENZIE & MANN, contractors for the Lake Dauphin Railway, have been notified by Premier Greenway, of Manitoba, railway commissioner, to cease in their construction operations on the road, and the workmen have been recalled. The intention was to construct the additional 25 miles this summer, connecting the line with Lake Winnipegosis.

ON the 1st June the Dominion Government ceased to operate the Baie de Chaleurs Railway, which has been handed over to the Atlantic and Lake Superior Railway Company. The rolling stock of the old road is mostly under seizure, and the A. and L. S. Co. have to supply rolling stock to keep it going The extension will be built when the company can finance its bonds under the arrangement with the late provincial Government.

ACCORDING to the Golden, B.C., *Era*, a recent washout on the C.P.R. swept away sixteen bridges and culverts, including the Kananaskis, Devil's Head and Calgary bridges. The formation, it adds, was swept out for about twelve miles, and fully 500 eastbound passengers were detained at Banff, where they were cared for by the company. Canmore was flooded, Calgary, too, and at Anthracite horses in McNeill's mine were drowned and the mine filled.

THE contract for building the East Richelieu Valley Railway, running from the town of Iberville, Que., to Lacolle bridge, a distance of 23 miles, as been awarded to J. L. Comte, of Montreal. The work will be finished this fall. There are no bridges of importance on the line, which has been subsidized by both the Quebec and Ottawa Governments to the extent of $8,500 per mile. Philip Roy, advocate, of Montreal, is the president of the company.

WHILE at Golden, B.C., recently, General Manager Whyte, of the C.P.R., stated that it had been found necessary for the better working of the Rocky Mountain section between Golden and Laggan, to make Golden the divisional point, and to establish workshops there. Consequently, the workshops will have to be removed from Donald, part going to Revelstoke, and the remainder to Golden. Car repairing shops will also be built. It is understood the C.P.R. shops at Canmore will be moved east to Calgary.

A GRAND TRUNK special train with the passengers from the Boston express, has made a remarkably fast run from Montreal to Sarnia. The train was running to make the connection with the Grand Trunk Chicago express, and left Montreal at 12.50 midnight on the 16th ult. Toronto was reached at 9.05 a.m. on Friday, and Sarnia tunnel at 12.48

in the afternoon. The entire distance, 503½ miles, was covered in 11 hours and 58 minutes, the time between the two points being cut down 2 hours 17 minutes.

A CABLEGRAM from London states that the capital of $400,000 has been subscribed for the Cassiar Railway, in the Cassiar district, in northern B. C. The company are working under a provincial charter which gives a lease of 700,000 acres of land, and rights to all minerals, including gold and silver, found therein. Parties connected with the Transvaal mining enterprises are behind the company, and it is expected it will lead to a large development of the rich Cassiar district, lying as it does between the Kootenay and the Yukon gold fields on the north.

C.P.R. stock has advanced from 46 in April to 72½ at the end of July, and no doubt it will go above this figure if the increased dividend, which has been unofficially announced, is declared in October next. It was in 1892 when the stock went to 90, and the earnings were away up. However, the returns are all right for the last six months. The net increase in the receipts for the six months ending June 30th reaches $558,000 over the same period of last year, so that there can be no difficulty about the increased dividend when the money is already earned to pay it.

IT is said that if the Klondike excitement continues the C.P.R. will extend the Calgary and Edmonton branch to Athabasca Landing, thus reducing the land route from that point to Fort Mackenzie near the mouth of the Mackenzie River, to one portage of less than twenty miles. It is stated that by a direct route from Edmonton the Landing can be reached by forty miles of track, but, as it is not probable that the Saskatchewan can be crossed at Edmonton, the impression is that from fifty to sixty miles of railway will have to be built.

THE contract for the Ottawa and New York Railway from Cornwall to Ottawa, about 52 miles, and the link on the American side of the river, which, with the Northern New York Railway, already built, will complete the connection with the Delaware and Hudson Company, has been let and work will begin as soon as the line is finally located. Two parties of engineers have been at work from both ends of the line and have nearly completed their survey. The contract calls for the completion of the line between Cornwall and Ottawa within 90 days from the time of breaking the ground. The scheme includes the bridges across the St. Lawrence from the main shore, a short distance above the town of Cornwall, to Massena Point, New York State, crossing the main line of the river to Cornwall Island, thence across the south channel to the American shore.

THE annual union meeting of the Brotherhood of Locomotive Engineers of North America was held in Windsor, Ont., July 14th and 15th. The gathering, which was held last year at Ottawa, is more of a social than of a business nature, but in spite of this fact there are about 300 delegates with their wives and daughters in attendance from all parts of Canada and the United States. Among the Canadian delegates present are: Chas. Clarke, London; Jas. Duffy, St. Thomas; W. H. Anderson, Moncton, N.B; J Adams, London; Henry Wheatley, Montreal; Jas. Currie, Smith's Falls; Thos. Mans, Hamilton; C. Lulunireve, Montreal; W. Newcomb, Hamilton; M. Lenahan, London; W. Burnip, St. Thomas; J. Neilson, Albert McGuire, Toronto; G. A. Kantley, Mandon, N.B.; R. G. Morris, Brockville; J. F. Drummond, Palmerston; H. Stagg, Ottawa; Thos. Bruce, Point Edward; H. Clendennen, Ottawa; P. Endrock, Stratford; W. C. Alison, Lindsay; W. H. Paisley, Brockville; W. Newcomb, Hamilton. The morning session, which was secret, was presided over by Grand Chief Arthur. The principal topic of discussion was one which for years has engaged the attention of all classes of organized labor, namely, the confederation of railway labor organizations. The discussion of the subject was spirited throughout, but it is understood that no definite action was taken. At 11 o'clock a civic deputation, consisting of Mayor Davis and Ald. Byron, Bell, Connolly, Duck, and Carney, arrived at Laing's hall, where the sessions are being held, and presented to Chief Arthur an address of welcome. This was replied to in a felicitous manner by Mr. Arthur, who in a few well chosen remarks thanked the deputation for its welcome. This ended the morning session, and after luncheon the ladies of the party were taken for a ride on the river. Another secret session was held in the afternoon, the subject discussed being on much the same lines as at the morning session. In the evening the delegates were entertained at a concert given in their honor at the Opera House. Among the speakers were Mayor Davis, William McGregor, M.P., and M. K. Cowan, M.P. for South Essex. The morning's session of the 15th brought the meeting to a close. The only officers of the brotherhood in attendance are Chief Arthur and Grand Secretary W. B. Prenter, who is also treasurer of the Order.

# Personal.

THE assistant city engineer of Toronto, Charles E. Rust, has been appointed on the council of the Canadian Society of Civil Engineers, in place of the late Alan McDougall.

WM. H. DERRY, of Kingston, has been appointed chief engineer of the Kingston Penitentiary in succession to James Devlin, recently dismissed in consequence of the disclosures of the parliamentary commission.

JAMES HERRIOT, who has been for a number of years in the car department of the Grand Trunk at Toronto, has been transferred to the office of Mr. McWood, superintendent of the car department in Montreal.

BY an agreement made between the Quebec City Exposition Company and the Provincial Government, the company has engaged to erect its new buildings at Stadacona, and to contribute $6,000 to the erection of an iron bridge across the St. Charles River, in place of the Bickell bridge.

JOHN S. DENNIS has resigned his position as director of irrigation surveys in the N.W.T., and has accepted the office of director of public works under the North-West Government. He will take with him S. C. Wilson, who has been employed for some months in the irrigation office at Calgary.

IT is probable that in the retirement of P. S. Archibald, chief engineer of I.C.R., W. B. Mackenzie, of Moncton, second in rank to Mr. Archibald, will be promoted to the chief engineership. Mr. Mackenzie is a native of Barney's River, Pictou county, and an engineer of high standing.—*Halifax Chronicle.*

PROF. J. C. K. Laflamme, rector of Laval University, Quebec, left last month for Russia, to attend the international convention of geologists, at St. Petersburg. Prof. Laflamme is not only an eminent geologist, but is a man of varied scientific attainments, and Canada cannot be more ably represented than by him.

R. O. KING, B.A., Sc, of 503 Markham street, Toronto, lately referred to as having received the Whitney fellowship at Harvard University, has just received notice of the exceptional renewal of his science research scholarship from the British Association for a third term, which will be taken at Harvard University. The financial value of these awards for the coming term amounts to $1,050.

A JOINT board of surveyors has been appointed by the Governments of Canada, Ontario and Manitoba, to delimit the boundary between Manitoba and Ontario from the northwest angle of the Lake of the Woods, north to English River. E. Stewart, Rat Portage, Ont., Government mining agent, represents the Dominion Government. B. J. Saunders, C.E., Brockville represents the Ontario Government. The survey is necessary at the present time owing to the number of mining claims being taken up in the vicinity of this territory.

DANIEL HUNTER, formerly of the firm of Inglis & Hunter, boilermakers, Toronto, died last month, after a protracted illness, at the age of 57. He first settled in Campbellville, on coming to Canada from Ireland, and afterwards moved to Guelph, where he became a member of the firm of Inglis & Hunter. About fifteen years ago the firm came to Toronto. A few years ago Mr. Hunter left this firm, and since then has been connected with the Doty and Bertram companies. He superintended the putting in of the machinery on the "Corona," this being the last contract which he managed. He leaves a widow and family of eight children.

FEW railway officials in this country were more genuinely liked than J. J. Lanning, late assistant general manager of the Grand Trunk, and there was sincere grief when his death was announced in Montreal last month A biographical sketch of Mr. Lanning appeared in our issue of April, 1894, at which time he was promoted from the position of private secretary to the manager's assistant. He had enjoyed his promotion but a short time when he was laid up with consumption, from which he never recovered, though almost to the last he cherished the hope of soon being "in harness" again. It would have been hard to find an officer more faithful to his work than Mr. Lanning, whose career ran through the regime of four general managers. At the suggestion of General Manager Hays, Mr. Lanning compiled, during his hours of compulsory retirement, a history of the Grand Trunk system, which will, no doubt, see the light in due course, and prove interesting reading.

THE late A. L. Light, M.I.C.E., who died recently at Lac-a-la-Croix, Que., in his early youth, was employed in the construction of the Great Western Railway of Upper Canada. Subsequently he became a member of the Institute of Civil Engineers of London, and

entered into partnership with Mr., afterwards Sir James Brunlees, the celebrated Scotch engineer, who built the cantilever bridge over the Firth of Forth. Mr. Light was employed by the New Brunswick Government in building the European and South American Railway from Shadiac to St. John, by the Government of Canada in the construction of the Intercolonial, and by the Government of Quebec in completing the North Shore Railway, now part of the Canadian Pacific. His last engineering work was the Lake St. John Railway, of which he was consulting engineer for many years. Mr. Light was very highly esteemed in England and was selected by the late Duke of Newcastle as civil engineer in charge of the transportation of the troops to Bic, at the time of the Trent affair in 1861. He was chosen by Premier DeBoucherville, of Quebec, in 1877, to take charge of the railways in Quebec province, and he has resided in Quebec city ever since.

It is with feelings of the deepest regret that we refer to the death, on July 20th, of F. B. Robb, manager and secretary-treasurer of the Robb Engineering Co., Limited, of Amherst, N.S., which took place while he was bathing at McIvor's Point, Fox Harbor. Mr. Robb was not in particularly robust health at the time, and it is thought that the shock of entering the cold water was so great as to produce heart failure. From early in his life Mr. Robb had been connected with a successful business and was a leading member of the community in which he lived. In everything which concerned the public welfare and the moral advancement of the citizens he took a deep interest. He was chiefly instrumental in organizing the Boys' Branch of the Y.M.C.A., and it was while taking part in the out-door life of this society that he met his death. He was an active member of the Presbyterian church, was an elder and taught the young men's Bible class in Sunday school. Mr. Robb was an excellent musician, and when a leader was required to take charge of a musical programme, he was willing to give his talents to its aid. He was active in the formation of the local bicycle club and contributed largely to its funds. He was a member of the Good Roads Committee of the Canadian Wheelmen's Association, and at the time of his death was identified with many plans for the improvement of the country roads. Thus at every point in which Mr. Robb came in contact with the world his influence was felt for good, and no one could be more missed from his native city than he.

## Marine News.

The Furness line steamer "Baltimore City" was wrecked in the Straits of Belle Isle recently.

The new steel barkt. "Hillside," owned by W. L. Lovitt, Yarmouth, N.S., recently arrived at that port.

The new Star line river boat, which has been in the process of construction for several months at McGuiggan's ship yard, St. John, N.B., was successfully launched last month.

The new D. A. R. steamer "Prince Edward," recently launched at Hull, is 700 tons register, with twin screws. She cost over $200,000, and is to be a sister ship to the "Prince Rupert."

The incorporators of the Rainy Lake Navigation Co. are: Geo. H. Bertram, Toronto; W. Ross, Rat Portage; G. A. Graham, A. Thompson, D. C Graham and J. T. Horne, Fort William. Capital, $150,000; chief place of business, Rat Portage, Ont.

In commenting on the novel features of the yachting and fisheries exhibition at the Imperial Institute, London, England, the *Yachtsman* says: "An oil launch, exhibited by Murray & Williams, of Montreal, apart from the points of detail, which we must describe on another occasion, seems calculated, from the manner in which it is prepared for exhibition, to teach even old stagers on this side a lesson or two, and should bring home the fact that white flannels are not so necessarily entirely out of place on a small steam yacht as some would have us think."

## Electric Flashes.

The officers of the West Kootenay Light and Power Co. are: Oliver Durant, president; J. B. McArthur, secretary; F. Paul, treasurer.

Waterloo, Ont., is now lighted by electric light. The plant supplied Wm. Snider & Co. by the W. A. Johnson Co., Toronto, is affording every satisfaction.

The Brantford, Ont., Electric and Operating Company have been awarded the contract for wiring and installing an electric light in the main building at the Asylum for the Blind, Brantford, by the Ontario Department of Public Works.

The Royal Electric Co. have the contract for lighting the buildings and grounds of the Montreal Exhibition which is to be held from 19th to 28th Aug., and have a large number of men on the grounds.

The Bell Telephone Co. is building a new exchange in Sherbrooke, Que. It is of pressed brick, with terra cotta facings, about 26 x 45, and three stories high. It will be equipped with the most modern switchboards and will be ready for occupation about December next.

The Sherbrooke Street Railway Company has closed a contract with the Jenckes Machine Company, Sherbrooke, Que., for a 45-inch Crocker turbine, with tubing and wheel cases complete, horizontal setting, for direct connection to generator, which is being furnished by the General Electric Company.

A company is formed to build a telegraph line from Dyea to Dawson, Alaska, with a branch to Juneau. It is the Alaska Telegraph and Telephone Company. The directors are C. W. Wright, Theodore Richart, D. E. Bohenon, J. W. Wright and J. F. Fassett. The capital stock of the organization is $250,000, of which $100,000 has been subscribed by the directors.

The town of Lachute Que., population about 1,700, has an electric light system, operated by Simpson & Boyd, under the superintendence of Henri Tessier. They have a 30-h.p. water power and run 350 incandescent lights. Houses are lighted at 1½ cents per light per night. The consumer pays for installation, and may find his own lamps if he chooses. Accounts are payable monthly.

A St. Catharines despatch of July 9th says: "The well-known car manufacturers, Patterson & Corbin, have been in an exceedingly unfortunate position lately. Their shop has been closed for a few weeks, and a Hamilton bailiff is in charge. Yesterday afternoon the place was to have been put up at auction to satisfy a claim, but Bailiff Boyle stepped in on the behalf of Collector McGibbon, and the sale was put off."

The Montreal Belt Line, the new electric railway, has been formally opened by a band concert, pic-nic and fireworks at Bout de l'Isle, a village at the foot of Montreal Island, forming the present terminus of the road. The road has been excellently equipped by the Canadian General Electric Co., and is very popular with the citizens. The line makes a junction with the city system at Maisonneuve, and is 12 miles long.

The Canadian Power Co., referred to last month, is proceeding with work at Niagara Falls. The plans on file at Ottawa call for a canal 4,000 feet long, 15 feet deep, and 200 feet wide at the bottom, running from Chippewa Creek to the head of Dufferin Islands. The *Globe* says: "The company's organization is held in the background for a time, and the only known representatives are Banker R Paine, of Niagara Falls, and Arthur C. Dennison, of Philadelphia. The company, according to Mr. Paine's statements, will develop 40,000 horse power at once, and about one-fourth of this will be for direct power use for mills, while 30,000 horse power will be developed in electrical form and transmitted."

The water was let into the head race of the big works of the Lachine Rapids Hydraulic Co. on the 31st without any ceremony, but the formal opening will take place somewhere about Sept. 1st. In the meantime the wheels and four of the twelve dynamos will be operated for 30 days by the contractors before the company takes them over. The company have issued a circular stating that they are prepared to furnish light and power to all comers, and claim that their power will be the cheapest in Canada. They will furnish light at ½c. per hour, but do not give figures for power. There is likely to be keen competition between this corporation and the Royal Electric Company, who supply most of the light and power to Montreal.

At the annual meeting of the Royal Electric Co. last month, the old board of directors was re-elected, and Hon. J. R. Thibaudeau was re-elected president, and D. Morrice vice-president. The annual report shows that the company has now $1,810,444 invested in machinery, plant and patents; it has $200,000 stock in the Chambly Mfg. Co., and $184,909 in outside plants, etc. These items, with goods manufactured and in process, make the total assets $2,978,095. The net profits (after deducting $43,245 for interest and fixed charges) for the year were $200,634, or 13.38 per cent. on the paid-up capital Adding $75,000 as premium on the sale of new stock, the profits would be over 18 per cent. on the capital. The company are now working actively on the electrical equipment required for the generating station at Chambly and the receiving station in Montreal. The building of the dams, power-house and waterworks is well under way, and in a few months the company will be able to deliver on its lines in Montreal electric power generated at Chambly, and to give its customers the benefit of the reduction in cost to be derived thereby without impairing its own earning powers.

DURING the past year the Royal Electric Company, of Montreal, have been busy replacing all the old step-down transformers in this city with new ones, suited for the low-frequency alternating current which they are now supplying for incandescent lighting. Last summer the alternations were about 15,800 per minute, while this year they have been reduced to 8,920. This change of frequency has had the effect of so much reducing the "back kick" in the iron of the transformers used last year, as to cause them to draw a large amount of current, and consequently render them liable to burn out; hence the replacing with new ones. Alternating current motors have also had to be re-wound to enable them to run on this circuit. The first means employed to adapt high-frequency motors to the low-frequency was to simply place a small kicking coil in the circuit, but this method has been abandoned, as by far the best results are obtained by re-winding. This has to be done with smaller wire and nearly double the number of turns. We have seen a fan motor wound for the 104 volt high frequency (which is still supplied by the Citizens' Light and Power Co.) run splendidly on the 52 volt low frequency. In all probability the 104 volt circuit will soon be changed from a high to a low frequency, when all transformers on the line will have to be changed in the same way as the Royal Electric Co. have been doing.

# Industrial Notes.

LINDSAY, ONT., recently ordered a road roller and other good roads machinery.

THE J. A. Sayward Lumber Company has decided to build a saw mill at Nelson, B.C.

THE new match factory at Buckingham, Que., is reported to be doing a good business.

THE Frost Wire Fence Co., of Cleveland, O., contemplate starting a branch factory in Ontario.

CITY Engineer Beaudry of Sherbrooke, Que., is preparing plans for a new system of waterworks.

THE Northern Elevator Company is building a thirty thousand bushel elevator at Regina, N.W.T.

THE Rathbun Company, Deseronto, Ont., is erecting a large lumber shed on its dock at Picton, Ont.

W. H. KELLY, Buckingham, Que., is building a new steam saw mill of a capacity of 50,000 feet per day.

A LARGE pulp mill will be, it is said, built at once at Escuminac, Que., on the Baie des Chaleurs Railway.

A NEW Catholic church is to be erected in Barford, Que. The contract has been let to Paquette & Godbout for $14,800.

EXTENSIVE additions and improvements will be made to the Russell House, Ottawa, this summer, at a cost of about $12,000.

JAS. A. SIMPSON, formerly engineer at the Berlin, Ont., Water Works pumping station, has been succeeded by Wm. Collard.

THE Arrow Milling Co, Birtle, Man., has made a contract with Stuart & Harper, Winnipeg, to overhaul and improve their mill.

A LARGE number of grain elevators are being erected in Manitoba this year, and the aggregate capacity of the province will be increased over 25 per cent.

THE Granby Rubber Co.'s box factory is now turning out 500 cases a day. The Robb Engineering Co. equipped the power. The factory is 36 x 84 feet.

C. J. ROBERTSON, printers' machinery and supplies, 12 Phillips square, Montreal, will make an interesting display at the approaching exhibition in Montreal.

JOHN M. MOORE, civil engineer, of the London, Ont., waterworks staff, has made a report to the town council of Ailsa Craig, Ont., on their proposed waterworks scheme.

AT the last regular meeting of the Brockville, Ont., branch of the C.A.S.E., it was decided to hold the annual convention in Brockville, Thursday and Friday, the 19th and 20th August.

J. R. BOOTH and G. A. Mountain, C.E., engineer of the C.A.R. system, have been in Parry Sound superintending the erection of a one million bushel grain elevator in that town.

THE Hamilton Smelting Works is sub-letting work, such as unloading and loading cars, and so forth. P. C. Peterson, ex foreman at the works, has been awarded three contracts.

PEUCHEN & Co., acetic acid manufacturers of Toronto, Ont., will establish a branch at North Tonawanda, N Y. The firm has leased the old buildings of the Spang Manufacturing Company.

THE town of St. Mary's, Ont., through the medium of W. K. McLeod, secretary of the Board of Trade, is investigating the question of putting in a system of waterworks for the town.

RUDOLPH HERRING, the New York engineer, has returned to Winnipeg to complete his investigations as to the best source of the city's water supply. He is said to favor artesian wells.

THE sum of $1,800 was allowed the Gartshore-Thompson Pipe and Foundry Company for its loss by fire a few weeks ago. The loss was much greater, but the foundry was not fully insured.

THE Jenckes Machine Company, Sherbrooke, Que., has just completed the balance of the sawmill machinery for the Montague Paper Company, Lake Megantic, which expects to start its new mills at once,

HARRISON BROS. have let the contract for the erection of a 75-barrel flour mill at Holmfield, Man. Stuart & Harper, of Winnipeg, who represent the Stratford Mill Building Company, have the contract.

THE Three Rivers Iron Works Company has been awarded the contract for the laying of mains for the waterworks and sewerage system of Renfrew, Ont., for $51,874. The stand pipe, pumps and plant will be awarded as a separate contract.

THE Cooper Machine Company, Limited 92 Adelaide st. east, Toronto, report a good demand for their "Imperial" gasoline engine, and have recently made shipments to Bracebridge, Ont., Goderich, Ont., and Pawtucket, Rhode Island. They are increasing their facilities by the addition of larger machinery of the latest design. The firm will make an exhibit at the Toronto Industrial Fair.

A NEW industry for Guelph, Ont., is the Guelph Linseed Oil Company, Limited. This business will be carried on in a portion of the building occupied by the Guelph Flax Mill Company, and will be run in connection with the present business under the management of S. J. Taylor. The company will manufacture linseed oil, oil cake, flax meal and green tow, and will give steady employment to about 20 men.

THREE new bridges have recently been completed at the Record Foundry and Machine Co.'s works in Moncton, N.B. They are for College Bridge, Blackville, N.B., and Campbell's, near Nauwigewauk, N.B. The Campbell bridge consists of a single span of 240 feet in length. The College bridge consists of two spans, each of about 200 feet. The Blackville bridge is smaller, being a single span of about 200 feet.

IT is understood that the Minister of Railways and Canals has authorized the construction of a new bridge to take the place of the present bridge over the Lachine canal at Seigneurs street, Montreal. The new bridge will be large enough for street car tracks as well as vehicle and foot passenger traffic. A new bridge may also be built over the canal at the foot of Atwater Avenue, which divides the city from St. Henri.

THE three sets of plans for the water and sewage systems of Nelson, B.C., prepared by Messrs. Cummings, Coyle and McCulloch, have been accepted by the council, and each competitor was awarded $200. The reports favor Anderson creek as a source of water supply, and also agree as to the site for the reservoir. The estimated cost is between $1,900 and half that sum. A. L McCulloch has been appointed engineer in charge with a salary of $200 per month.

THE work of restoring the malleable works is now in full swing, says the Whitby *Chronicle*, and will be pushed to completion as rapidly as possible. Jas. Gall has the contract for the stone and brick work. Don Valley pressed brick will be used for the front wall, and Whitby brick for the balance of the work. John Sykes & Son have the contract for woodwork. Goldie & McCulloch, of Galt, will supply the engines. It is expected that the works will be restored by September 1st.

MARSH & HENTHORN have succeeded to the foundry business of the Geo. T. Brown Manufacturing Co., Ltd., Belleville, Ont. L. W. Marsh has been accountant with the Geo. J. Brown Co. for about four years, and W. H. Henthorn has been mechanical superintendent for that company for about nine years. The new firm has already supplied three steam hoists to Wm. Gibson, M.P., for use on the Victoria bridge at Montreal, and in his quarries, and has several large orders on hand.

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# The Canadian Engineer

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

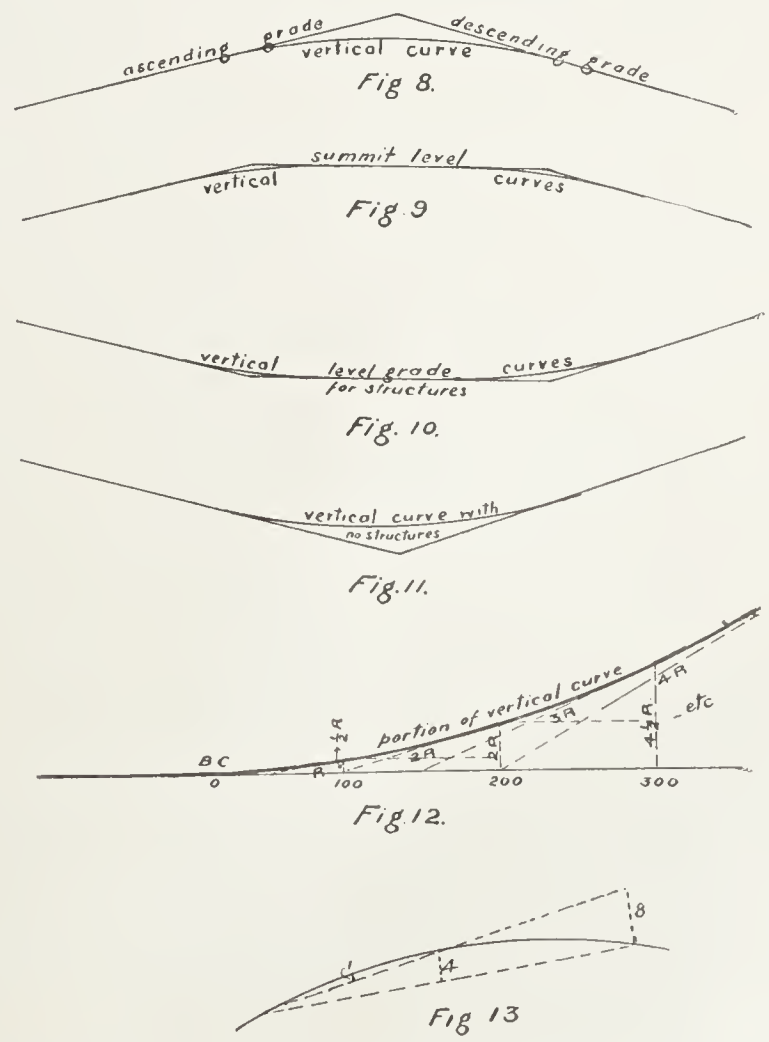
### CHAPTER III.

### CURVES—(*continued*).

### ARTICLE 8—VERTICAL CURVES.

Wherever there is a change in the rate of grade there must be a vertical angle or a vertical curve. If this change is slight, less, say, than $\frac{3}{10}$ feet per 100 feet, no need exists, either on construction or afterwards, of doing anything more than to let the trackmen put in a slight curve by eye, but when the change is of considerable magnitude, care should be taken, both for the sake of appearance and also for safety, that a regular vertical curve unites the two grade lines.

In the past, in America, this has not been often done. If ascending and descending grades were to be united, a short piece of level grade was inserted at the summits and in the depressions; anything further was, curiously enough, relegated to the track gang as being a refinement unnecessary for a civil engineer to bother with; the track or section foreman, with greater appreciation of the real need for a regular increment of change from one grade to another, did the best he could and put in vertical curves by eye, which moderated the ill-effects of such neglect. Wellington has ably dealt with the subject, at length, from the standpoint of the link-and-pin coupler, and demonstrates that the vertical curve which is needed, theoretically, is one which will change the rate of grade from the front to the rear of the longest trains run over the road by an amount not greater than the grade of repose (the grade of repose is that grade down which a train will just keep moving under its own weight, and is about $\frac{5}{10}$ per cent. for loaded trains at a speed of 25 miles per hour, and increases with the speed). He reasons thus: Taking the train as a whole, each car will momentarily crowd toward the one in front of it, and so on throughout the whole length of the train, putting it in a state of compression, with slackened couplers if the grade resistance at the front of the train is enough greater than at the back end to exceed the grade of repose. This is based on an assumption of uniform engine power, and should the engine driver increase speed just at this instant, when everything is slack, the tendency will be to create severe jerks and oscillations causing derailments. This reasoning refers entirely to a grade depression, whereas at a summit the reverse will happen and the couplers will be momentarily strained much more than normally. From these premises we can see that the vertical curve at summits may be arbitrary in amount and much sharper than in depressions. Probably a change in rate of grade of $\frac{2}{10}$ per cent. for each 100 feet is not excessive, and may be inserted either as a complete curve joining the ascending and descending grades (see Fig. 8), or if the summit level is long it may be divided into two portions (see Fig. 9). When, however, a descending grade is to be




united to a level or ascending grade, an accurate calculation should be made for reasons already given. For in-

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

stance, supposing that the longest train on the road will be 500 feet (engine and 14 cars), then

$$\frac{\frac{5}{10}\text{ per cent.} \times 100}{500} = \frac{1}{10}\text{ per cent. change}$$

per 100 feet will be the amount strictly demanded for complete safety on a road of the given length of train using link and pin couplers. But as automatic vertical plane couplers, with practically no slack, come more generally into use, which is only a question of a few years, the need for such extensive curves will not be imperative, and a vertical curve changing more rapidly will answer fully, when a longer curve is difficult to obtain. Usually, however, a level grade between the descending and ascending grades is required, because a structure should always be placed on a uniform grade from end to end, and as they are usually in the depressions, this limits the vertical curve in such cases to two short pieces joining the level grade to the others. (See Fig. 10.) If there is no break in the embankment a continuous vertical curve is much better from every point of view, and should be put in as in Fig. 11.

On roads having only light grades, and consequently heavier and longer trains, the rate of change in depressions will be very small, and circumstances will determine whether the full amount can be put in without excessive cost; but with light grades and easy vertical curves, the distance which the middle of the curve will rise above the point of intersection is small. It may be calculated, in any case, in the same manner as the middle distance in horizontal circular curves, if the vertical curve is treated as a circle, or if treated more precisely as a parabola, it may be stated at once as half the distance which the apex is from the middle of a cord drawn from one end of the vertical curve to the other, this being a fundamental equation of the parabola.

(*a*) Treating the vertical curve as an arc of a circle, calculate first the permissible change in grade per 100 feet divide this into the total change of grade, giving the total length of curve, $\frac{1}{2}$ of which will be on each side of the apex of grades; then the position of the curve for each 100 feet relatively to the tangent lines may be obtained graphically on a large scaled drawing, or calculated more precisely as in ordinary horizontal circular curves.

(*b*) Treating the vertical curve as a parabola having a constant rate of change of direction per 100 feet, is more precise and more convenient. Calculate first the length of curve, which will be the same as in (*a*), and then proceed as follows: Let the change of grade per 100 feet = R. Then referring to figure 12—, the departure of the curve from the tangent will be $\frac{1}{2}$R, 2R, $4\frac{1}{2}$R, 8R, $12\frac{1}{2}$R, . . . . . etc., till the middle of the curve is reached, after which the distances from the second tangent will recede . . . . $12\frac{1}{2}$R, 8R, $4\frac{1}{2}$R, 2R, $\frac{1}{2}$R, to the other end. It will be seen that by the latter method the elevations are always in even units or portions of units, and the rise of the curve above the tangents is given almost by inspection; for convenience the length of a vertical curve should be fixed at the nearest *even* hundred feet, so that the curve may be divided into two equal parts of exact hundreds in length. Such vertical curves, with their elevations once established, will be no more difficult to place on the ground and build to than a succession of straight lines with abrupt changes in grade, and will give a track safer in depressions, having better drainage in summit cuts, and better in every respect, but increasing the cost of the road-bed slightly.

### Art. 9.—Horizontal Circular Curves.

It is not necessary to treat here of the mathematics of the circle. There are several engineering field books which have considerable space devoted to methods of placing curves on the ground under ordinary or exceptional circumstances. Some of these books also contain, in addition to ordinary mathematical tables, tables of external secants and of sub-tangents for each degree of curve, and for each interval of one minute in the total intersection angle; these books are great time-savers in field operations, and should always be used.

In placing curves on the ground, it is preferable to establish the two tangents first, intersect them and measure in the BC and EC from the intersection or apex; then the curve can be run in from either or both ends and any error minimized. With very long flat curves on unstable ground, it may even be preferable to fix the middle of curve from the apex by measuring in the external secant, and then run the curve in from the ends and middle; the method sometimes adopted of running a curve in from the BC, and deflecting on to the second tangent at the EC, is very liable to establish it erroneously.

Another very important point is the method of keeping curve notes. The vernier should always read half of the total deflection of the curve from the BC up to the point on the curve toward which the telescope is pointing; this is a constant index of the position of any point. This method necessitates loosening the vernier-plate at each set-up and re-setting it to read the index reading of the back-sight; but it has the all important feature of enabling a transit to be set up at any point on a curve, and being sighted to any other point with a certain knowledge of what the vernier reading should be. Curves can be run in backward as easily as forward. Any other method of keeping notes will be found, in the end, less reliable and convenient. Whenever curves are sharper than 4° or 5° it is better to put in stakes every 50 feet even on easy ground, as the difference between the length of chord and curve for 100 feet measurements would be considerable; it is also convenient for cross-sectioning. In running in sharp curves, particularly curves having a large intersection angle, the greatest care is necessary in the chaining; poor results in checking up at the EC are usually traceable to the errors in measuring the subtangents or the curve itself.

It is often necessary to replace stakes that have been lost, or to put in intermediate stakes on curves without the aid of a transit; whenever this is the case it is valuable to remember the following formula, which is approximately true for all curves usually used on steam railways:

It is $O = .218\ N^2D$... ..... .....(11)

Where $O$ = offset from middle of a chord to the curve (in feet)

$N$ = length of chord in 100 feet.

$D$ = degree of curve.

Or, if simpler, remember that the offset from the middle of a 100-feet chord on a 1° curve is .22 feet, and that

(1) Offsets vary directly as the degree of curve.

(2) Offsets vary as the square of the length of chord, which is true up to 200 or 300 feet chords.

(3) Offsets, inward to a curve, from a prolonged chord are 8 times the offsets from the middle of the same length of chord outward to the same curve. This is illustrated in Fig. 13.

Circular curves are in general use on railways, but there have been isolated attempts at using the parabola, which have not been found satisfactory. The idea involved in its use was to have a curve of easy radius at the ends and sharper in the middle, but the train did not travel steadily, being in a constant state of change from beginning to end of curve. It has been found from the very

first days of railroads that an annoying and dangerous jolt, sidewise, took place as a train either entered or left a curve, and the parabola was a first or rather a mistaken idea as to remedying this evil.

Instead of this, the concensus of opinion has fixed itself on the use of the circular curve, but with the modification of the use of easement curves at each end of it to join it on to the tangents in such a manner as to modify or wholly dissipate any disagreeable shock which would occur if the curve were to change instantaneously to a straight line. In the past the trackmen have been allowed to introduce these easements themselves in an approximate and make-shift manner, but at present there is a growing feeling that an accurately calculated and placed easement curve is necessary, especially as passenger speeds are becoming higher. Easement curves have been used for many years in Europe, and are becoming quite common in America.

## CONDENSERS.*

BY E. J. PHILIP, TORONTO.

The condenser may be said to have the inverse relation to the steam that the boiler has, for as the boiler raises the temperature of the water and increases its volume, the condenser reduces the temperature and volume. The boiler converts the water into steam, and the condenser reconverts the steam into water. The advantage of running condensing instead of exhausting against the pressure of the atmosphere is explained by reference to the principle by which the maximum efficiency of heat engines is calculated. For example, suppose two engines exactly alike and each driving the same load, each working with steam of say 60 lbs. pressure absolute, one working with a condenser and the other exhausting into the air, suppose one engine expands down to 3 lbs. absolute, the other to 2 lbs. above atmosphere or 17 lbs. absolute, the relative efficiency of the two engines may be expressed as follows: The temperature of steam at 60 lbs. absolute is 292.7, that of steam at 17 lbs. absolute is 219, and of 3 lbs. 141.5.

$$\frac{292.7 - 141.5}{461 + 292.7} = \frac{151.2}{753.7}$$

while that of the non-condensing engine is

$$\frac{292.7 - 219}{461 + 292.7} = \frac{73.7}{753.7}$$

or in the ratio of 73.7 to 151.2, or as 18 is to 37. From a mechanical point of view the advantages are more apparent as illustrated by an indicator diagram, for it enables us to reduce the back pressure from, say 2 lbs. above to 12 lbs. below the temperature of the atmosphere.

Condensing allows us to make use of much higher grades of expansion than is possible by non-condensing. The condenser itself is an apparatus into which the steam is discharged when it has done its work, where it comes into contact with a jet of water, or else with a large surface one side of which is kept cool by contact with water. The steam entering the condenser is instantly condensed, giving up its heat to the water. The result would be a practically perfect vacuum only for the fact that the feed water contains air which the steam gives up during condensation, and causes a back pressure on the piston. An air pump is attached to a condenser to pump out the air and the water of condensation, and in the jet condenser it has also to pump out the injection water and the air it contains.

There are many forms of the different types of condensers. The best known type is the jet condenser, once used almost universally when pressures did not exceed 35 pounds. It consists essentially of an air tight chamber into which the exhaust steam passes from the cylinder after having done its work. It is met on entering by a jet of water caused by the inrush of water through holes or slits in the pipe placed across the opening, or by many other spraying contrivances. If the water enters through holes in a shower, it mixes mechanically with the steam; if it enters through slits, it causes the water to enter like broad, thin sheets, and the cooling is done principally by surface contacts. In either case the result is the same: the turning of the steam into water, and it falls to the bottom of the condenser and is pumped out by the air pump.

It might be supposed that the mere turning of the steam into water, thereby causing it to occupy less space, will cause the vacuum. It does, but to so slight an extent that unless some other means to maintain it were provided the condenser would be useless, for the reason that water readily absorbs air when exposed to it, and gives it up again on being boiled. The feed water contains air, which becomes mechanically mixed with the steam in the boiler, and passes with it through the engine to the condenser, where it is freed from it when the steam is condensed, and remains as cool air. In the jet condenser the cooling water also contains air, and under the partial vacuum and the temperature of the exhaust steam it readily gives some of it up. The engine has only to make a few strokes without the air pump, when the air will have accumulated so as to raise the pressure to that of the atmosphere, and although the condenser may be kept cool there will be no vacuum. Now the water that has accumulated from the steam being condensed, might be arranged to run away by gravity; it is only the air that is of necessity pumped out, and hence the pump, although pumping both air and water, is rightly named the air-pump. The jet condenser has been made in many different shapes. The essential feature is that the inlet for the steam prevents the water running back to the engine, in case of flooding. A good arrangement for mixing the steam and water is to have the bottom so formed that the water will all drain into the air pump. Condensers are made to suit the various conditions and positions. In marine work they are made to suit the relative positions of engine and hull, and was often a part of the engine frame.

The columns of vertical engines were used for this purpose until the practice was forbidden by the Admiralty, but they are so used in some cases yet. The capacity of the jet condenser is usually one-third the capacity of the engine, and should not be less than one-fourth or more than one-half. The objection to a large one is, besides its extra weight and first cost, the longer time required to form a good vacuum. The objection to a small one is the liability of flooding. The quantity of injection water varies, and it depends on the temperature of the steam and its weight, also the temperature of the injection water and the water in the hot well.

The feed water is usually taken from the hot well, and there is an advantage in having it as hot as possible without impairing the vacuum. Therefore there should be just sufficient injection water used to cool the steam down to the required point to get a good vacuum with a jet condenser; 24 inches is a good vacuum; 25 inches is the most economical point. The temperature due to 24 inches vacuum is 140°. In actual practice the temperature of the hot well varies from 110° to 120°, but it can be got up to 130° with great care. To calculate the quantity of injection water per pound of steam to be condensed, let $T$ be the total heat of the steam; let T be the temperature

*A paper read before the C.A.S.E. convention at Brockville.

of the cooling water and t the temperature of the hot well, and Q the quantity of cooling water per pound of water in the steam.

Then $Q = \frac{T - t}{t - T.}$ This is the number of lbs. of cooling water for each lb. of water in the steam. Example: Find the amount of injection water required. Exhaust 19½ lbs. injection water, 60; hot well, 110:

$$\frac{1182.1 - 110}{110 - 60} = 21.44, \text{ or } \frac{1114 + .3 \times 227 - 110}{110 - 60} = 21.44.$$

Pressure began to rise above 35 lbs.; the jet condenser was abandoned, and the surface condenser began to take its place. One of the principal causes was on account of the feed water carrying so much salt, which, as the water in the boiler was evaporated, became so saturated as to be eventually deposited on the plates, and thus destroy the boiler. The only way to avoid this was to blow off some of the brine and feed in some with less salt. The hot water blown away caused a large loss of heat, varying according to the different degrees of saturation. The maximum density is three times that of sea water. The loss was generally from 12 to 15 per cent. of the fuel supply. In order to stop this loss it became necessary to feed the boilers with fresh water. This could only be done by keeping the steam and condensing water separated, and this led to the surface condenser. Another reason was that in order to effect any considerable economy in the engine, it became necessary to raise the steam pressure. Now if the pressure be raised above 35 lbs., the temperature of which is 280, the sulphate of lime in the sea water is deposited in hard insoluble layers on the heating surface, and destroys its efficiency. To obviate this, it became necessary to use fresh water, which was another reason for the surface condenser.

The amount of water required with a surface condenser is from 30 to 40 per cent. greater than with a jet condenser. In experiment, it was found that sheet copper backed by water condensed from 21 to 50 lbs., and under special conditions 100 lbs. per square foot per hour. It is usual, however, to allow only 12 to 13 lbs. per square foot per hour, for ordinary compound engines. In a surface condenser, the circulating water must be kept in constant circulation to realize the greatest efficiency by keeping up as great a difference of temperature between the two sides of the plates. The air pump, with the surface condenser, is much smaller than with the jet; but the condenser is much larger, heavier and more costly than the jet.

The amount of cooling surface allowed per h.-p. varies from 1¾ to 3 square feet, but is usually 2 or 2½. The surface used is now always brass tubing. In former times copper tubing was used, as it was such a good conductor of heat, and had the qualities to resist the varying strains and temperatures, and it could be drawn out very thin; but it was found that the acids from the fatty matter used in cylinders dissolved some of the copper, and formed soluble copper salts which was fed into the boilers with the feed water, and did great damage to the boiler. This gave the surface condenser a set back, as the saving was offset by the extra wear and tear on the boilers. To prevent this, the tubes were coated with tin inside and out, and this partly prevented the trouble, but not altogether. Brass tubes were tried, and after getting the proper mixture proved a perfect success. Much has been said about the corrosive action of distilled water; but most of the trouble from pitting and corrosion in boilers and their fittings using distilled water has been found to be the action of the water on something else, and the matter formed is what does the damage to the boiler.

Before closing with condensers, I will say a few words about the necessary complement of the condenser, the air pump, of which there are different types. The most efficient, the writer believes, is the single acting vertical pump, having valves in the bucket, as well as foot and delivery valves. This is a very familiar form of pump. Another is the double acting, made both vertical and horizontal, having a piston with foot and delivery valves at each end. In most of the stationary plants the air pump is of this type and driven by an independent steam cylinder. This is a good arrangement, as a vacuum can be produced before starting the main engine. The disadvantage is, it is the most wasteful way of operating the pump. In marine engines the pump is usually driven from the cross-head and is generally single acting. The advantage of this arrangement is the pump is driven at least expense for power. The efficiency of the single acting pump is due to its certainty of taking the water through the bucket valves, and to the certainty of the valves closing, due to their position; also the valves are always flooded with water and the clearage may be reduced to a minimum.

The size of the air pump can be calculated theoretically, and it has been found that the single-acting pump, working under favorable conditions, has an efficiency of .6 and varies to .4. The efficiency of the double-acting pump may be taken as from .5 to .3. The size may be taken as three times what theory demands. With a surface condenser there is also a circulating pump to circulate the water through the tubes. In stationary work, the pumps are arranged with the steam cylinder in the middle, with the air-pump at one end and circulating pump at the other, all on one rod. In marine work some use an independent pump, either an ordinary double-acting plunger or a centrifugal pump. Others use a single or double-acting pump driven from the main engine. The capacity of the circulating pump may be calculated the same way as the air-pump. The centrifugal pump has many advantages as a circulating pump, if the lift is not great. It has no valves to interfere with the flow of water or get out of order. Being worked by a separate engine, it can be started before the main engine, and keeps the condenser cool while warming up. Having an independent engine, the quantity of water may be varied to suit conditions, the power to run it varying in proportion. The supply of water is continuous, thereby avoiding all shock to the condenser and piping, and its efficiency is greater for low lifts than any reciprocating pump.

Another type of condenser I will just mention is the ejector condenser, which is perfectly satisfactory under certain conditions. The principle on which it works is the same as the ejector, but the water should have a small head to make it work satisfactorily when as good a vacuum can be maintained as with any other type. The water should not be over 60°, although it has been used at a higher temperature. The rise in temperature is usually about 20 or 25°, but in experiments it has been raised 60 to 64 with a final temperature of 120°, but under these conditions the vacuum fell considerably. In this type the power to run the air pump is saved; these condensers have also been made to lift their own water, but under these conditions they are unreliable.

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THE Carlisle Packing Company, Victoria, B.C., is now exporting canned salmon in tin cans which have a porcelain lining. If these cans can be produced at a reasonable price, their use should enormously extend the Canadian trade in canned fish, fruits, etc., as in this way the goods could be indefinitely preserved without danger of becoming poisoned by the corrosion of the can.

*For* The Canadian Engineer.

## THE MINERALS OF NEWFOUNDLAND.

BY AN OLD RESIDENT OF ST. JOHN'S.

Newfoundland as a field for legitimate mining, which, with intelligent management and moderate capital, would return handsome dividends, seems to have been hitherto almost entirely overlooked. In the December issue of The Canadian Engineer, 1895, there were notes from the pen of the late Geo. Spotswood, C.E., on the petroleum fields which he had then partially examined, and of which a few months prior to his death he had been in charge, and had successfully developed. Unfortunately this was at the cost of a valuable life. Anxiety and exposure in getting the first well completed and the second started hastened the course of a disease he had contracted, and which resulted fatally in November, 1896.

The geology of the field as determined from his partial examination is shown in the report to the company which is operating the claim located by him in October, 1894: "The geological formation belongs to the Quebec group—consisting of limestone, limestone conglomerates, shales and sandstones, with dips from 30° to 80° and strikes varying from 220° to 250°."

An analysis of the crude oil was made by J. T. Donald, of Montreal, on September 27, 1894, and was as follows:—

| | | | |
|---|---|---|---|
| Specific gravity .... | .885, or 28 B. | Burning oil.. | 14.50 per cent. |
| Water ..... | traces. | Heavy or lub. | 82.50 " |
| Gasoline ..... | none. | Solid res .... | 3.00 " |
| Naphtha ..... | " | Sulphur .... | .098 |

This analysis was made from crude oil gathered from the surface depressions; when the wells were sunk it was found that the oil at 1,000 feet was much lighter, and gave a higher percentage of illuminating oil, as shown by the following report of Rufus Merrill, who refined a sample of the crude.

"Color, dark olive green; gravity, 36° B. at 60° F. Odor, aromatic. Yielded by destructive distillation.

| | | |
|---|---|---|
| Naphtha ..... | 7 | per cent. |
| Ill. Oil ..... | 56 | " |
| Lub. Oil ..... | 34 | " |
| Coke ..... | 3 | " |
| | 100 | " |

"This oil belongs to the aromatic petroleums and is of the paraffine series; the products of distillation are of bland and pleasant odor, easily refined, and yield more readily to and require less acid and alkali than any of the oils found in the United States. The illuminating oils are high fire test water white, and burn with a clear lambent flame of great brilliancy and less tendency to smoke than the best United States oils. The crude oil is very free from grit and foreign substances, and with proper reduction would make a first class natural lubricant; finally, there is no known field which to-day produces an oil of equal quality."

The territory appears to cover about 250 square miles, but beyond the wells sunk by the Newfoundland Oil Company, which are producing, and one ten miles further north, there is no development. An English company is negotiating for the Newfoundland Oil Company's property, but whether they will finally close the deal cannot be stated; it is to be hoped that either an English or Canadian company will secure the territory, and not let the United States refiners step in, as usual, and gather the financial honey which our people should get. If the Newfoundland Oil Company does not sell it will probably refine the oil on the spot, and ship to England; they are on the seaboard, and 6½ to 10 miles of pipe will put the product of the wells at tide-water.

Asbestos properties on the west coast must very soon be a factor in the asbestos market. On a claim which the writer knows there is an inexhaustible quantity of low-grade and a very large quantity of high grade ore, which can be mined and sold, on account of the favorable situation, for very little more than it costs to mine in Quebec. I am aware that the Quebec miners are sceptical about the asbestos in Newfoundland, but some day they will have an object lesson that will open their eyes to the facts in this case.

The minerals, etc., so far found in Newfoundland, in economic—and probably economic—quantities, are gold, silver, lead, iron (both magnetic and hematite), coal, copper, nickel, asbestos, gypsum (no deposit in any known country so large), marbles of the most beautiful kinds, chromic iron, manganese, and molybdenum.

Mining in that country has suffered from two things—ignorant and most unskillful management and over capitalization, for both of which the English operators are principally to blame.

## THE INDICATOR.*

BY G. B. RISLER, LONDON, ONT.

The indicator is an indispensable assistant to the engineer, and of late years it has become evident that intelligent and wideawake steam plant owners recognize the necessity for such a valuable instrument, and they are also appreciating the services of the engineer who is competent to use it properly.

The indicator diagram is actually the only means of showing on paper what really takes place in a cylinder. To read an indicator card correctly is not an easy matter, and in order to be able to do so, considerable study and practice are necessary. The handling of such a delicate instrument requires a great deal of care, and sometimes considerable skill and ingenuity must be employed in making the needed attachments. By its use many stumbling-blocks will be removed, while the calculations and geometrical work which the engineer will be impelled to make in connection with it will lead to the acquisition of a good general knowledge of the whole subject. Careful consideration of the diagrams from different engines, under varied conditions, cannot fail to lead to thought and investigation. A general knowledge of the law of gases (especially Mariotte's law) is needed, and a study of physics, mensuration and mechanics is most beneficial.

In order to determine the most economical plan of operating a steam plant, many tests are made. Such tests, if properly conducted, are valuable, and are much to be appreciated by steam plant owners, who will find it to their interest to give every encouragement and assistance to the engineer along this line. The diagrams traced by the indicator pencil will vary widely, and depend on the condition of the different engines from which they are taken, and it therefore becomes necessary to know how to interpret these variations correctly. This information the engineer can only acquire through the processes of reasoning and hard study. In attaching the indicator considerable skill is sometimes needed, and circumstances must determine what plan can best be employed. The reducing motion must be such that it will give to the paper barrel in its reduced scale an exact reproduction of the movement of the piston.

Examine your indicator, and see that every part of it is moving freely, has no lost motion, and is well oiled. A

*A paper read before the Canadian Association of Stationary Engineers' Annua Convention, Brockville.

cord that will stretch is to be avoided. Good judgment is required in putting the proper tension on the paper barrel spring for differently speeded engines. The indicator springs should be tested occasionally to see if they agree with a standard steam gauge of known accuracy. Do not use too light a spring for the pressure. If the instrument is a reliable one, and the necessary precautions have been taken in every particular, the diagram will then show you the pressure acting on the piston on both sides, and at any part of the stroke during one revolution of the engine, and that is all it will do. Knowing the scale of the spring, it is an easy matter to determine the pressure at any point of the stroke. This little tell-tale instrument will leave on a piece of paper a good deal of information, providing the atmospheric pressure line is properly established on the diagram. It is of the greatest importance that this line be drawn correctly, as it is the neutral line of the diagram, and from it all pressures above and below must be determined. After removing the card from the paper barrel, it is advisable that all data be made on it as complete as possible, and then will its study be pleasant and profitable.

The following terms are used in speaking of the different lines and curves: The atmospheric line, vacuum line, admission line, steam line, exhaust line, counter pressure line, compression and expansion curve. The beginning and termination of some of these lines are called points, and their continuation indicates periods in the stroke of the piston. Technical terms for pressure are as follows: Boiler pressure, absolute pressure, initial pressure, cut-off pressure, terminal pressure, back pressure, and mean effective pressure. The mean effective pressure is what we must find in order to calculate the indicated horse-power of the engine, and the indicator card is the only means of getting it correctly.

Having once established the mean effective pressure from the diagram, the work done in one stroke, in foot pounds, can be calculated as follows: Multiply 144 by the mean effective pressure, and by the cylinder volume in cubic feet, displaced by the piston. Two simple and easily remembered rules for finding the indicated horse-power when the mean effective pressure is known, are as follows: 1. Multiply the mean effective pressure by the cylinder area in square inches and by the piston speed in feet per minute, and divide by 33,000. 2. Multiply the mean effective pressure by the length of the stroke in feet, by the area of the cylinder in square inches, and the number of strokes per minute, and this, divided by 33,000, will equal the indicated horse-power. From the foregoing it can easily be seen that the indicator is invaluable in determining the work done by an engine.

But this is not all, by any means. An analysis of the expansion curve, which requires considerable knowledge and accurate working from a geometrical and arithmetical standpoint, is of great value, and the nearer the actual expansion curve of the diagram approaches the theoretical (often called the equilateral hyperbola), the greater will be the economy. A considerable deviation from the actual and the hyperbolic curve impels the engineer to think and to reason out the cause. A leaky piston, a leaky steam valve, re-evaporation in a cylinder, or a leaky exhaust valve—all these tend to bring about an expansion curve, which is not in accordance with the law of gases laid down by Mariotte, viz., that the volume should vary inversely as the pressure. This, of course, is to some extent an impossibility in an engine cylinder, owing to loss of heat and leakage. Nevertheless, diagrams have been taken from steam engines which are a credit to the engineer, as well as to the engine builder, and are almost identical in the expansion curve to the hyperbola. It is not advisable to come to hasty conclusions in regard to the expansion and compression curve, as well as other lines, because the laws of nature can have quite an influence in this respect, owing to the surroundings and conditions under which a steam engine may be working. The engineer well knows that dry steam should be furnished to an engine; therefore, it is reasonable to state that the steam boiler at times can be held responsible for a diagram which does not approach the ideal. If the steam pipe leading to the boiler is too small in diameter, the indicator diagram will give an indication of it, but this should be verified with the diagrams taken direct from the steam chest or the steam pipe. The indicator card will furnish the means of knowing how the steam is distributed in the cylinder. If the valve gear is not properly working the card will show it. With calculations from the diagram we can find with what sort of economy, mechanically and thermodynamically, the engine is working, and if underloaded or overloaded the engineer will be in a position to advise his employer exactly what changes should be made in order to insure greater economy in fuel. The steam line may show considerable initial expansion or loss of boiler pressure, and the back pressure line can point out excessive resistance to the piston. Both cases are evidence of wasteful expenditure of steam.

Economy to the engineer means keeping down the fuel account, having small bills for repairs, little or no loss from shut-downs, regular speed, and the least possible loss from deterioration. The engineer must be guided by circumstances, and if he finds himself confronted with conditions that render the attaining of strict economy impossible, he then can only make the best of bad surroundings. Steam engine economy is made up of many factors, and it is to be hoped that the endless study and exertion on the part of the intelligent and ambitious engineer will be appreciated by the employer.

It is my belief that many steam plant owners or managers are willing to assist the engineer financially in obtaining such an instrument as the indicator, as well as other most valuable appliances which would serve as aids in many instances to the greatest economy.

My employers, The *Advertiser* Printing and Publishing Company, of London, have recognized the wisdom of this, and assisted me to the extent of $50 in purchasing an indicator in 1893, and also obtaining for me in 1896 a free engineer's scholarship with the International Correspondence Schools in Scranton, Pa.

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*For* THE CANADIAN ENGINEER.

## COMPOUND, DIAGONAL PADDLE ENGINES.

On page 127 is shown the side elevation and plan of the engines of the steel paddle steamer being built by the Polson Iron Works, of Toronto, for the Pembroke Navigation Co., from the designs of Arch. P. Rankin, consulting engineer, of Toronto.

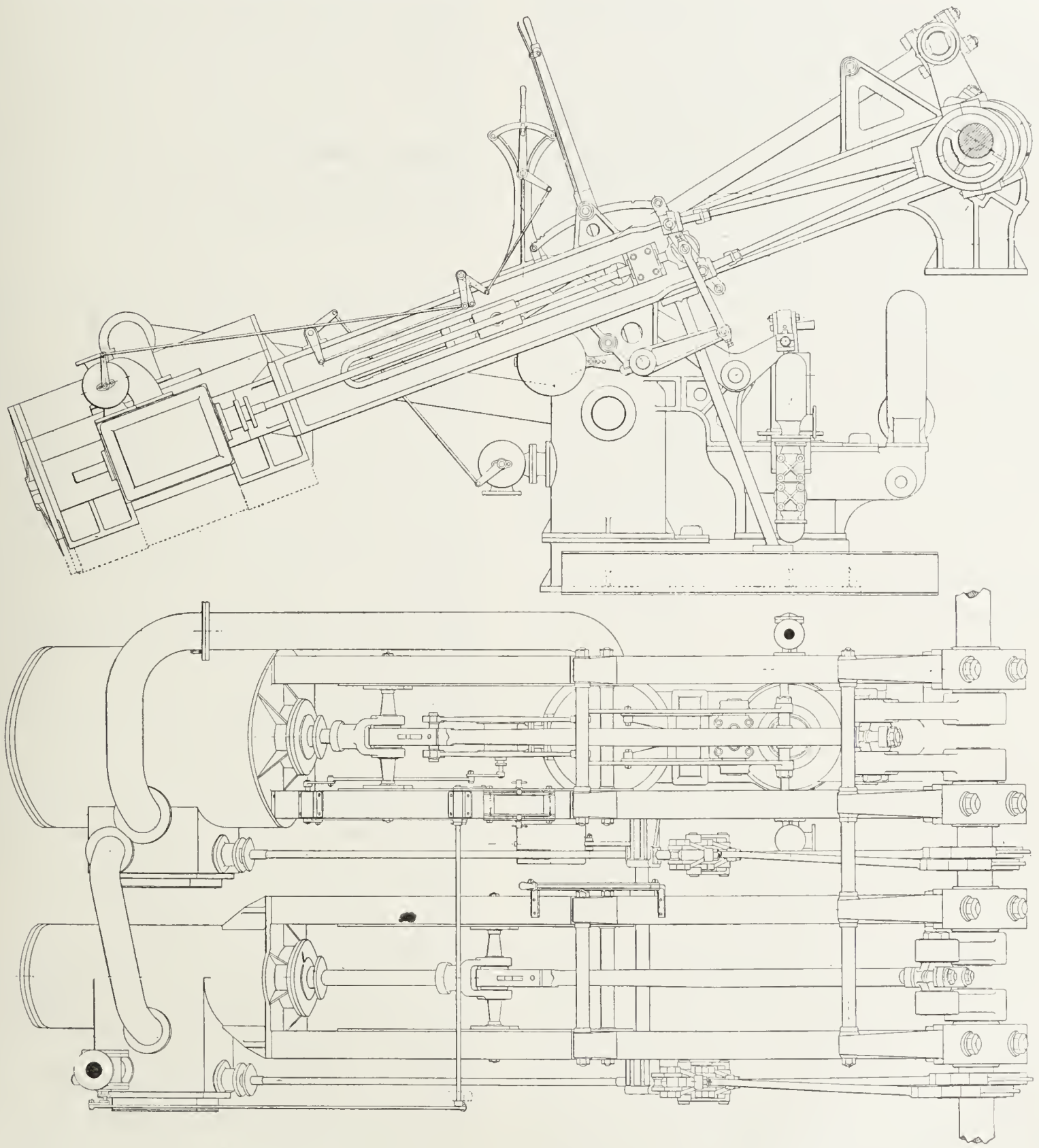
The hull, which is of steel throughout, is 125 feet long, 21 feet beam, 7 feet 6 inches deep, and 4 feet 9 inches draught, and the estimated speed is 14 miles per hour.

The engines are of the compound, direct-acting, diagonal type, which has of late years become very popular for paddle steamers, its chief advantages among others being that the weight is better distributed along the keel, and the stresses set up by its action are chiefly in a fore and aft, and downward direction, and therefore easily resisted by the natural structure of the vessel. Moreover, with this class of engine the chief working parts are in full view of the engineer from the starting

platform, and are easily got at for adjustment and repairs.

The high and low pressure are respectively 17 inches and 34 inches diameter, with a piston stroke of 48 inches, connected to each other only by the exhaust pipe. Both cylinders are supported on a diagonal stool built of steel plate and angles, riveted to the floors of the ship, with gusset plate extensions so as to form a transverse girder under the cylinders. Slide valves are fitted to each cylinder; the H.P. being an ordinary single ported, and the L.P. a "trick" valve giving a double opening to steam.

The pistons are hollow box castings fitted with two



INCL. COMP. ENG. 17 & 34 x 48. SCALE 1 INCH = 1 FOOT. GENERAL SIDE ELEVATION AND GENERAL DRAWING PLAN.
BY A. P. RANKIN.

"Ramsbottom" rings each, the piston rods being of steel, secured to pistons by taper and nut, and keyed to the crossheads, which are steel castings. The cast-iron slippers work in guides in the main frames, and are fitted with large adjustable bronze plates.

The connecting rods, which are 10 feet, or two and one half times the stroke, between centres, are of malleable iron, parallel in diameter for one half their length, and tapering towards crosshead end, and are fitted at ends with brasses of large surface, which are easily adjustable.

The cranks are steel castings keyed to intermediate shaft, at right angles to each other, with H.P. leading, the crank-pins being secured to inner cranks by taper and nut, and free to some extent to move in outer cranks between steel plates. The shafting is of best hammered scrap, the main bearings being eight inches diameter by 10½ inches long, while the outboard bearings are nine inches diameter by 16 inches long. The main bearings, four in number, are formed with the main frame castings, and are supported on a shelf piece the width of the engine hatch athwart ship, which shelf is carried by a bulkhead extending across the ship almost directly under the centre line of shaft. The shelf is also supported, and the bulkhead stiffened, by fore and aft plates and gussets, under the centre of each bearing; this construction giving great transverse stiffness under the shaft, and ensuring the bearings being held in perfect alignment.

The main frames are of cast iron, of open girder section, suitable openings for the crosshead guides being formed in them, and the brackets for cross stays and reversing shaft bearings cast on. They are secured to cylinder ends by fitted bolts and studs, and each frame is supported at about the centre of its length by a diagonal stay, the bottom end of which rests on a steel I beam riveted to the floors of ship. The frames are connected together in pairs above and below the guides by stays

and distance pieces, and are tied by a continuous cross stay above the four main bearings.

The valve gear is of very substantial design of the double bar, link motion type, all wearing surfaces being large and adjustable. The eccentric rods are of wrought iron, with T end for attaching to straps, and fitted at link ends with cast steel forks and adjustable brasses. These rods are comparatively short, and the valve spindles are correspondingly long, thus making the parts to be moved by the reversing lever lighter, and facilitating the handling of the engine. The reversing lever is 7 feet long, stands 5 feet above the starting platform, and has a travel from "full ahead" to "full astern" of 4 feet 6 inches. The quadrant with the lever for operating the throttle and injection valves, is fastened to one of the main frames at a convenient distance from the reversing lever.

The condensing apparatus is placed below the L.P. engine, resting on the ship's floors. The air pump is vertical, single-acting, fitted with bucket and delivery valves, and connected to the jet condenser by a channel plate, in which is located the foot valve. From the ends of the air pump crosshead, the feed and bilge pumps are driven, the whole of the pumps being operated through wrought-iron levers and drag links from the crosshead end of L.P. connecting-rod. A bilge injection valve is fitted so that, when necessary, the bilges may be pumped out by the main engines through the air pump. The valves of all the pumps are arranged so as to be easily accessible.

The paddle-wheels are radial, 14 feet effective diameter, each wheel having 14 floats 4 feet 6 inches wide.

Steam is supplied by two steel boilers 54 inches diameter by 20 feet long, of the locomotive type, placed forward of the engines. They are built for a working pressure of 130 lbs. per sq. inch.

The estimated horse-power of the engines, at 40 revolutions per minute, is 300.

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*For* THE CANADIAN ENGINEER.

## SEWAGE DISPOSAL.

BY WILLIAM M. WATSON.

In previous articles on sewage disposal the writer described the International Purification System, which uses ferrozone for a precipitant and polarite for a filtrate. Compositions of the ferrozone and polarite used were also explained, and he commented on the cost and efficiency of the system. The Rivers Purification Company's system was taken up, which purifies sewage by carbonized refuse, such as vegetable garbage, excrements, etc., collected in towns, brought to a red heat in a muffled kiln and afterwards used to filter and purify the town's sewage. There was also a detailed description of the workings of the Bradford, Eng., sewage works, where a precipitant of milk of lime was used. The Amines system of using a mixture of herring brine and lime, the Conders process of using a solution of lime, and the native guano process were dealt with. All of these can be studied in the back numbers of THE CANADIAN ENGINEER.

I then stated that purification by land was impossible on account of the extreme climatic influences in this country, and even in a very mild climate such as New Zealand the land is often unsuitable Irrigation lands should be gritty and porous to a depth, at least, of four feet, and should be well and carefully under-drained. It was formerly supposed that vegetation was the principal factor in the cleaning and purifying process. In summer, vegetation will extract the manurial constituents, and powerfully assist in destroying the bacteria. But careful experiments prove that farm land is really a process of filtering, and that the purification is effected by oxidation. Therefore, irrigation lands must have periods of rest to allow time to secure aeration, and should never be drowned or water-logged; and to prevent it doing so, provision should be made to store the sewage during storms or severe frosts. By having separate drains for the carriage of sewage the flooding can be avoided, but I see little chance of providing for long periods of frost except by going to the unreasonable expense of covering the irrigation land in winter.

If the land is composed of adhesive loam, light loam, or light gravelly soil, the whole of the organic matter contained in the sewage can be removed. The underdrains should be in short lengths, close together, say every two feet, and the discharge end terminate in an open channel, so that air could freely pass through them to the land. Nearly all public authorities owning irrigation works consider that an untrained farm laborer is able to manage the works, the result being that, say, the $100,000 spent in shaking up the land and underdraining is lost, because the land gets fat and useless, the drains are choked, and the sewage passes through untreated.

Broad irrigation is effected by running the sewage direct on to farm lands, and on account of the tenacity of soil in holding in suspense moisture, sufficient land must be acquired to allow one square yard to each two gallons of sewage discharged per day in dry weather. The land would sometimes absorb a great deal more, but it requires to have periods of rest sometimes for as much as a month, and it is unsafe to allow an average of more than two gallons per yard per day. The amount could be increased by doing some draining to draw off the moisture. The land on the slope of a hill is the most suitable; low, flat land that is often waterlogged is useless. In most places it will necessitate pumping the sewage to the hill top. There is no fixed rule how to proceed in distributing the sewage on the land. Generally shallow channels are cut by a spade, and the sewage drawn from the nearest branch. Broad irrigation on farm lands is feasible where the city is built on a hill and there is plenty of arable land that is situated below the level of the main outlet of the sewer, and the land itself is high and dry above the storm water mark of the nearest water course. But except the town is fortunate enough to have these requirements, the system, if adopted, is expensive, and can only answer for a makeshift, useful in dry weather.

The Government in Great Britain for the past fifty years has demanded that all sewage shall pass through land during the final filtering stage. It happens that the majority of large towns are built in hollows and low lands bordering on the water courses, and on the banks of navigable rivers or seas, and only high enough to secure a good fall for the drains above the high water mark, and they cannot possibly introduce a simple inexpensive gravitation sewage works; but where six feet in depth can be secured it can be accomplished, by the screening bank and roughing filter being on the same level, then letting the clarified sewage come from the top of the roughing tank on to the land, thus doing without any machinery or sludge presses. Twenty feet is about the depth necessary to provide for the proper arrangement of a good self-acting works; it then gives space for mixing the precipitants by water power, and of shaking up the sewage water by water wheel or turbine, and the first or roughing filter can work downward, the clarified sewage passing out at the bottom of the tank and over a water wheel or rough stones to give it another shake up, and aerate it, then run along box-made channels on to the bacteria filter, composed of

fine charcoal, etc., made by the Jaggers' kilns from towns' refuse or other suitable material.

Where it is necessary for the roughing filter to work by an upward flow to save pumping, and where there is under 10 feet of depth to work on, it will require an apparatus to clear the sludge settling at the bottom of the tank. Candy invented a revolving pipe to suck it out, which is clumsy, and expensive, and soon disarranged. There is another method simpler, cheaper and more efficient.

Every system of purifying sewage depends largely on the qualification of the manager and attendant for its efficiency. To properly manage a sewage disposal works requires a man with a thoughtful and creative mind, well-informed on most technical subjects, one who will sift things to the bottom, and who will take a lively interest in his work.

The judgment used in selecting employees for such important and responsible positions, means the saving or the wasting of a large amount of money, and the improvement or decline of the general public's health. In fact, the success or failure of many costly sewage works is due to the personal qualities of the manager.

We now come to the precipitants, and my experience with regard to them is that there is considerable humbug in connection with them. There is a great variety of sewage; one is dye-polluted water, that is permeated by strong chemicals. The chemicals and colors having got a good grip on the dye water, then a chemical or other substance must be employed to compel them to let go their hold, and allow the water to return to its pure state. There are at least one hundred different kinds of precipitants used in Great Britain, and I believe that in half the cases powdered clay would answer for the purpose of dividing the solids from the water better than the more expensive precipitants. Clay has been successful when the chemicals would not make any impression. If many of the marketed precipitants that have high-sounding names are examined, powdered clay, and sometimes charcoal, will be found to form a part of the mixture.

The art of purifying sewage is now being revolutionized, and if it were not that the British people are very slow to take up a new idea, the general use of precipitants in England would have been a thing of the past some time ago.

The Messrs. Jaggers showed the officials their invention of carbonizing town refuse and afterwards using the product for purifying sewage, and proved that they could secure the best effluent, but the Local Government Board refused to permit works to be constructed without using irrigation land for the final process of filtration. And as the towns did not wish having two methods, they were compelled to obey orders (except a few like Baildon, which risked having their own way), and take the method of land irrigation, and to prevent the land from getting too fat or dirty, they are compelled to clarify the sewage in settling tanks, using precipitants to be able to handle it quickly—which, when the cost is placed alongside the cost of the new idea, is often about 75 per cent. more. Strange to say, we find that those towns which have lately got sewage works in Canada have selected a system or a mix up of the parts of several systems that can hardly do good work. The effluent discharged from them is probably dangerous.

An effluent may appear clean after clarification and the solids have been extracted by settling tanks and precipitants, but they have only taken out what is chiefly offensive to the eye, viz.: manurial, fœcal, and heavy substances that do little harm until allowed to putrefy, but the chief reason for needing purification is still in the sewage water, held in suspension, viz.: albuminoids, ammonia, free ammonia, chlorine, alkalies, etc, which are all good in their proper place, but are decidedly in the wrong place when they are in water that may be used to water cattle and promote fish life.

There is a kind of sewage discharged by slaughter houses, wool and skin washers, and by large hotels or restaurants, that is heavily charged with blood, grease and fat. By using a precipitant of bisulphide of carbon it may be made to settle down; but when the sludge is put into a press only 23 per cent. of the moisture can be extracted and the sludge still remains a liquid. If it could be pressed clear of the moisture and made into a cake, it would be valuable for fuel and gas making. Even after clarification the whole of the fat is not removed, and when it passes to the filters, stops up the air cells of the filtrate, of course partly destroying the filter's purifying power. Slaughter houses and wool and skin washers should always be compelled to clarify their sewage before discharging it into the public sewers. In England there is a firm contracts to extract the fat for the right of taking it away for sale. Hotels and restaurants should have a grease trap connected with kitchen and pantry sinks, for grease is the worst enemy to sewage works and drains.

Those towns which have adopted the Jaggers carbonized refuse filters can dispose of greasy sewage without the use of precipitants, because coming on to the filters in a raw state, and having to pass down through a fine powdered charcoal, it leaves the grease on the surface, which in a short time covers the filter and stops the flow, when it can be scraped off, along with about two inches of the charcoal which has become contaminated.

Mr. Pasteur and Mr. Warrington both declared years ago that sewage contained the organisms necessary for its own destruction, and with the combined efforts of engineers, chemists and biologists it will soon be accomplished. They have proved that there is a great variety of minute organisms in sewage and land, and that in the colonies of bacteria there is a marked difference in their tastes and habits. Some are very dangerous to the public health, and must be destroyed or they will destroy us. On the other hand, there are other colonies that, so far as the public health is concerned, are harmless, but they kill and destroy the dangerous ones. On this account we are now making the friendly ones useful by setting them to destroy the dangerous ones. And it is now believed that ever since 1762, when filtering sewage was begun to be cleaned by passing it through land, that it has always been partly done by our allies the bacteria, and only very slightly by growing vegetation. We now are certain that the filtrate, whether composed of sand, rubble, spar, coke, coke breeze, carbon and iron-coal, charcoal, or charcoal made from refuse, that its value consisted only in its qualifications for becoming a comfortable lodging house to the bacteria.

Now the latest improvement is purification by bacteria filters, sometimes called purifying by microbes. In England there are about five small towns working on this principle of allowing the sewage to purify itself by natural processes. Each of the places do it by different ways, and patents are, I believe, placed on each method. Some use the settling tanks and precipitants; others make a darkened tank answer in place of a precipitant and settling tank, and another by passing the raw sewage through a roughing filter to clarify, then through the bacteria filter to purify. The advantages of the bacteria filter are that it eats up all the injurious matter and dirt except grit,

sand, etc., and by so doing does away with sludge and expensive machinery used for mixing precipitants, pressing, pumping, etc., and perhaps the greatest advantage is that the works do not require so much depth as the old complicated system.

So it seems probable that the sewage works of the future will have a roughing filter, and if sufficient depth of land can be secured the sewage will be run on raw from the sewer. Then it will pass through carbon of some kind or a substance of a similar nature; then out at the bottom and through troughs to the filter, where it will be split up and rained on to the filter in small streams. Each filter will contain over three feet in thickness of filtrate properly packed together, but in such a manner that the air can get through and supply the bacteria with the oxygen they always need to assist them to carry on the work of nitrification, and enable them to discharge the hydrogen that they manufacture.

If there is not sufficient depth to allow both filters to have a downward flow, the roughing filter must work with an upward flow, which will save four feet, and it may have a very simple contrivance attached to clear the bottom of sludge and bring it to the surface of the ground. To work a sewage business of this kind will cost very little, and the cost of land and construction will be small in comparison to that, for instance, of the Hamilton, Ont., stamp. The filters can be constructed so that they will filter 200 gallons of sewage per square yard per day, or if you choose to say cubic yard per day, for we should make the filtrate at least a yard deep.

The next point is what is the best material for use as a filtrate. The State Sanitary Board of Massachusetts at Boston has conferred a great benefit on the world by making exhaustive experiments into the sewage purification business, also into the habits of bacteria life and their use for filtering purposes. They used sand of various kinds, pebbles, broken stone, gravel and similar materials, but no carbon of any kind or charcoal. They showed us how the climate acted on the filtering material and what season of the year the bacteria works the best. The stony kind of material is, in my opinion, too cold. In England, coke or coke breeze has been the favorite filtrate for a long time. I used this material and it gave fairly good results, but we knew of nothing better then. Mr. Garfield, the manager for Wolverhampton, Staffordshire, England, happened to observe a very filthy stream run on to a heap of soft coal screenings, and he also observed that when it run out at the bottom of the pile it was equal to spring water. Being an intelligent man, he lost nothing by his observation, but quickly tested its purifying power in his sewage works, which went all right; so they use small coal for filtering at Wolverhampton. This find is almost as good as a Klondike to England, because they have hundreds of large pit hills composed of screenings, shale, etc., that they formerly could not sell.

Having no coal to spare in this country, and seeing that we burn the very dust, the find will be of no value, only in places where a coal mine is located. Professor Peat for a short time purified sewage with wood charcoal and secured a pure effluent, but the cost could not be tolerated. Benj. and H. B. Jagger, of the Rivers Purification Company, Limited, of Southport, Eng., have found a method of making a powdered charcoal from towns' refuse and garbage, which answered even better than wood charcoal, and supplies a material that suits better than anything else for the bacteria filter.

The idea that charcoal was the best filtrate is very ancient. Where the Jaggers system is used, as at Baildon, Yorkshire, Eng., and other places, a muffled kiln is built near the filters, and the excrements from privies, ashes, vegetable refuse, street sweepings, bad meat, or any offensive material is taken and tipped into the destructor or kiln, brought to a red heat, then withdrawn, cooled and riddled, and then used to filter the sewage. It has been shown that it is necessary when constructing any kind of a sewage or water filter to make a proper provision for the passing of air through the filtrate. If they succeed in being able to aerate a filter, and at the same time be passing sewage through it, then the sewage works will need very little attention after having been once started, and the cost of management will be reduced to a fraction, because the sewage will be continually running through and there will be no machinery or sludge to care for. There are two patents already out which profess to be able to meet this requirement. Mr. Lowcock has got a method of putting perforated pipes in the centre of the filtrate, connected with a fan blower that is driven by power got from the stream of sewage coming down the sewer to the works. The fan forces the air into the filters at a pressure of five inches of water. He proves that this supplies all the needed oxygen, and there is no need to stop the filter to aerate. In my opinion the method will stand improving, for if the filtrate is water-logged or immersed in water I cannot see how five inches of pressure is going to travel 18 inches, and should it travel upward it will never travel downward and aerate the lower half. I am quite aware that the most work is done in the first 12 inches of filtrate at the top, and on this ground it may answer.

There is another inventor who builds the filtrate on a grating, leaving an air space of about a foot between the concrete bottom and the bearing grate. In the walls of the filter tank he builds a quantity of air shafts and raises them to several feet above the filter level, then fixes Howarth screw ventilators. These being driven by the wind of course create a vacuum in the air space under the bottom of the filtrate, which causes a quantity of air to come down with the water, for in this case the filter cannot be water-logged or the air space at bottom would be choked. Of course the water or effluent, when passing out of the filter, is trapped to prevent air coming in that way. I believe this system will be improved on, especially when the Jaggers system is the filtrate, because having considerable heat at the kiln it could be utilized to increase the draughts without using ventilators.

There is another way to aerate which certainly gives plenty of air to the filter, but requires a great deal of machinery and attention and makes it costly. It is used by the International Sewage Purification Company, in England, but, I believe, not by their agent out here. They found that passing water through even polarite (which is composed of sesquioxide of iron, 53.98; silica, 15.10; magnetic oxide of iron, 19.19; protoxide of iron, 7.25; calcium oxide, 1.42; carbon, 1.80) did not purify the water when kept running, and the Government inspectors would not permit the effluent to be discharged. They have now altered their system, and the sewage is discharged suddenly on to the filters by self-acting valves and troughs which are constructed to hold the quantity necessary for one charge. It is thrown on quickly, so that the air contained in the filtrate cannot escape. The sewage settles down, forcing the air before it, and as it lowers below the surface, of course draws a fresh supply of air into the polarite. It takes under two minutes to spread the water on, and they allow eighteen minutes to pass out, and the polarite to get re-aerated, so the cycle takes twenty minutes.

It is estimated that one thousand population discharges 156 pounds of solids and 260 gallons of urine each day. It appears to me to be a wilful waste to have all that valuable manure converted into hydrogen, and blown away for every plant to share in it, when by spreading it on our land it would enrich the land and increase the crops.

Sewage that is allowed to stand and ferment as it is in the sewage irrigation works at Berlin, Ont., and which contains about the usual amount of organic matter per gallon, will give out $1\frac{1}{5}$ cubic inches foul gas per hour per gallon. This shows that irrigation works where the land is allowed to get waterlogged, as the land does in Berlin, is a menace to the health of the country.

The average composition of the sewage in the small towns of Ontario is about as follows, viz. :

| | | |
|---|---|---|
| Organic matter..... | .....27.72 | grains to each gallon. |
| Nitrogen ..... | 6.21 | " " |
| Phosphoric acid ..... | 1.57 | " " |
| Potash, about ..... | 2.03 | " " |

When some of this weak sewage is placed under a powerful microscope it is shown to contain various dead and decaying matters, also multitudes of bacteria, but few of the higher class of microbes; neither does the heavier sewage, and when a new bacteria filter is started it must be supplied with a sufficient number of colonies of the sewage destroying kinds. So in the first place it must be filled by an effluent running from another filter and allowed to stand for a time until the bacteria can sufficiently increase.

## ROLLER BEARINGS.*

BY W. BAYLEY MARSHALL, M. INST. C.E.

The application of rolling motion to bearings has been rendered practical within the last year or two. The author referred to (*a*) the advantages which might reasonably be expected to accrue from the use of roller bearings, (*b*) the requirements of satisfactory bearings constructed on this principle, and (*c*) some of the results which have lately been obtained from the adaptation of such bearings to rolling stock and other purposes.

(*a*) *As to the advantages arising from the use of roller bearings.*—It is an interesting fact that although full knowledge has existed from the earliest days of the advantages of rolling motion when applied to tractive purposes, as shown by the use of wheels or rollers, for reducing the effort required to transport heavy loads, it is only within comparatively recent times that serious attempts have been made to substitute such motion for the ordinary rubbing or scrubbing friction between the axles or journals of such wheels or rollers and their bearings. If by the introduction of rolling motion between the journals and bearings of the rolling stock or between the wheels and axles of the road vehicles, as the case may be, a further and very considerable reduction in the effort required to move any given load can be obtained, and this at a comparatively small additional monetary expenditure, far outbalanced by the consequent economy, it would seem that such application must become general. The following are, amongst others, the principal advantages claimed for roller bearings: Great reduction in starting effort; decreased tractive effort; decreased revolving effort; economy in lubrication.

The reduction in the effort required to start vehicles or shafts fitted with roller bearings, as compared with those fitted with ordinary bearings, is of such importance that if it were the only advantage it would warrant the necessary additional monetary expenditure. Although it is not claimed that the reduction in tractive force will be so large in proportion to that in starting effort, it must be remembered that this force is in application during the whole of the time a vehicle is running on level ground or ascending gradients; this point, therefore, becomes of great importance when the total amount of work done is calculated.

The decreased revolving effort is of great economical value in all cases of heavily loaded shafting, as careful experiments have shown that the amount of power required to drive the main and counter shafts in workshops, all the tools being idle, amounts to as much as from 50 to 80 per cent. of the power required when all the tools are in full work; these figures show that there is ample room for improvement in shafting bearings. The economy in lubrication is a considerable item, seeing that a perfectly constructed roller bearing does not require any lubrication but only sufficient oil need be applied to prevent the rusting of the various parts.

The various parts must be proportioned with reference to their relative movements, so that nothing but rolling motion takes place between the surfaces engaged. The bearing rollers must be kept parallel with the axis of the axle or journal upon which they run, that they must not be allowed to touch each other, and that they must be of sufficient diameter and length to bear the fatigue of the duty they have to perform. Adequate provision must be made to meet the end thrust, not only of the rollers, but also of the axle or shaft when revolving within a fixed bearing, or of the bearing itself, when revolving upon a fixed axle. The bearing must contain as few working parts, and these as simple as possible. The most important from a commercial point of view is that the bearings shall be produced at reasonable cost.

For many years the only successful application of rolling motion to bearings was the well-known "ball-bearing" so universally adopted for cycles, and although these bearings have been found most satisfactory when subjected to light loads, all attempts to apply them to heavy ones have, so far as the author knows, resulted in failure, these failures arising chiefly from the balls indenting the paths or races upon which they run. Directly this takes place the balls begin to lose their friction-reducing properties. If a semi-circular trough be constructed which accurately fits a ball, and after the ball is placed therein, one end of the trough is lifted until movement of ball takes place, it will be found that the ball moves by sliding and not by rolling; this is indentation carried to its extreme limit. Another defect in the ball bearing is that the balls are allowed to touch each other, and as the touching points of any two balls are revolving in opposite directions, there must be a certain amount of scrubbing friction.

Improvements which have been made recently in the use of roller bearings are making their employment in general traction more common, and are seen on a number of English railways, on some of which the tests were made, from which the following data were compiled :

A passenger train of six carriages, fitted with roller bearings throughout, has been running for two years between Brighton and Kemp Town, with a total mileage of over 70,000, and has shown a saving of from $12\frac{1}{2}$ to 15 per cent. in the consumption of fuel, which saving has been obtained under most disadvantageous circumstances, inasmuch as the engine has to be kept in steam for about 16 hours per diem, whilst its actual running time is under seven hours.

A tramway car fitted with ordinary bearings and

* Abstract of a paper read before the Toronto meeting of the British Association for the Advancement of Science.

weighing 2 tons 15 cwt. was let loose from a point 56 feet up an incline with 1 foot 6¼ inches rise. It ran down this incline and 57 feet along the level line at foot of same, or a total distance of 113 feet. The force expended was therefore 6,160 lbs. falling through 1.521 etc., feet, or 9,364 foot-lbs. The average frictional resistance was 9,364 ÷ 113, or nearly 83 lbs., equal to 30.5 lbs. per ton. A similar car fitted with roller bearings being let loose from the same point, ran the full length of the level line available, namely, 320 feet, and had not then quite come to rest, the total distance traversed being 376 feet. The force expended was as above, 9,364 foot-lbs. The average frictional resistance was 9,364 ÷ 376 = 24.9 lbs., or about 9 lbs. per ton of load. A saving of 70 per cent. Relative starting effort of a tramcar on a gradient of 1 in 20, ordinary bearings 100, roller bearings 77, saving 23 per cent., ditto, ditto, on a gradient of 1 in 80, ordinary bearings 100, roller bearings 50, saving 50 per cent., ditto, ditto, on a gradient of 1 in 140, ordinary bearings 100, roller bearings 39.6, saving 60.4 per cent.—results which require no comment. Perhaps one of the most interesting amongst the general applications of these bearings is that of the big bell at St. Paul's Cathedral, "Great Paul," which with its headstock and other moving parts weighs nearly 25 tons, and which gave considerable trouble when mounted on ordinary bearings. The following results are instructive: When mounted on the ordinary bearings the bell came to rest—after the swinging effort had been discontinued—within one minute, when on roller bearings in 6 minutes 55 seconds, showing that the frictional resistance of the latter was only about one-seventh of the former, a result remarkably in accordance with the starting effort tests given under the head of "Tramways." With reference to the question of heating it is an interesting fact that there has not been a single case of a hot bearing in all the experience so far gained with roller bearings.

Although it is somewhat early to predict what the cost of maintaining these bearings will be, the results so far show that if they are constructed of suitable materials, it will be extremely low; 60,000 miles in railway work and over three years in tramway work, with but very slight wear are most encouraging. It has been found that polished compressed steel is the best material for the rollers, cast steel for the cases in railway and heavy shafting bearings, and hard cast iron for tramcar and other lightly loaded and slow-running bearings.

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We have been compelled to hold over a quantity of interesting matter, including a report of the meeting of the British Association for the Advancement of Science, held in Toronto last month.

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## UNUSUAL MINING.*

BY J. T. DONALD.

Lac a la Tortue (Turtle Lake), 21 miles from the city of Three Rivers, on the Piles branch of the Canadian Pacific Railway, is a very curious iron mine, worked by the Canadian Iron Furnace Company, which operates a modern water-jacket furnace at Radnor, 10 miles distant. This lake is a body of water about four miles long by one and one-quarter miles in average width, occupying the centre of a large area of swampy land. The surrounding land is largely composed of sand formed by the wearing down of the Archaean rocks by glacial action. It is well known that decaying vegetable matter yields acids that dissolve the oxide of iron. Evidence of this solvent action of vegetable acids on iron are frequently seen in pieces of slate. The slate is colored by iron, but frequently white or light-colored spots occur. These are points where a leaf or a fragment of bark has been deposited with the fine mud, in which form the slate was deposited. The leaf or bark has decayed; the vegetable acids thus formed have dissolved the iron oxide to which the color of the slate was due, and of course a white or colorless patch is formed.

In the sandy area around Lac a la Tortue we find the most favorable conditions for the action of vegetable acids on iron oxide. The sandy land produces a rank vegetation, and its decay furnishes abundance of organic acids. These acids are in solution in the drainage waters, which on their way to the lake percolate through the sand. They thus come into contact with the iron oxide in the finely divided materials, dissolve it, and carry it along to the lake. Here a new chemical action comes into play. The solution of iron in vegetable acid (in which the iron is in what the chemist calls the form of a protosalt) is oxidized by the action of the air on the surface of the lake into a persalt, which is insoluble, and appears on the surface in patches that display the peculiar iridescence characteristic of petroleum floating on water. Indeed, not infrequently these films of peroxide of iron are incorrectly attributed to petroleum. These films become heavy by addition of new particles, they sink through the water, and in this manner, in time, a large amount of the iron ore is deposited on the lake bottom. It must not be supposed that the ore is deposited as a fine mud or sediment. On the contrary, in this lake ore, as it is called, we have an excellent illustration of what is known as concretionary action—that is, the tendency of matter when in a fine state of division to aggregate its particles into masses about some central nucleus which may be a fragment of the sunken wood, a grain of sand, or indeed a preformed small mass of itself. Precipitated in water, as our lake ore is, it of course has great freedom of movement, and we, therefore, find it in flat concretions, more or less porous and circular in outline; the general appearance amply justifying the term "cake ore," which is locally applied. These concretions vary much in size, some of them being no longer than mustard seeds, others 8 or 10 or more inches in diameter. Frequently the larger cakes are joined together and form masses looking not unlike batches of a certain kind of bun commonly exposed in the shop window of every confectioner, and made by coiling a strip of dough round and round a piece of itself.

The ore is not found over the whole lake bottom; it occurs along the whole margin, and also well out from shore where streams enter the lake, the distance of the ore deposit from shore depending, of course, upon the volume of water carried by the streams and the velocity with which it enters the lake. Certain strips of ore occur at a considerable distance from the shore, and in as much as 16 ft. of water. These deep-water, mid-lake deposits denote probably the courses of former streams which are now non-existent, owing to some change of level. The ore is extracted from this lake-mine by hand and by power; the shallow margins are worked by hand, while from the deeper parts of the lake the ore is raised by means of a steam dredge.

A short time ago the writer was instructed by the proprietors to make an examination of the lake-mine and report the quantity of ore in sight. From the description of the mine already given, it will be seen that the task allotted was a somewhat unusual one. A certain amount of planning and experimenting was necessary before any satisfactory method of getting at the quantity could be determined upon, but finally the following method was adopted, and found to work admirably:

A number of lengths of 1-in. gas pipe were coupled into one length of about 30 ft., and this, resting on the stern of a scow, was pushed down into the water until the end rested on the bottom of the lake. The scow was towed by a tug backward and forward over the whole lake. When an ore deposit was reached, its presence was indicated by the vibratory motion of the long pipe, caused by the end slipping from cake to cake of the ore. When no ore was at hand the end of the pipe slid smoothly along the firm sand, for fortunately nothing coarser than sand is found in the lake except ore cakes. When a deposit of ore had been located and its superficial extent determined as above indicated, the quantity of ore per square foot of each deposit was determined as follows: An iron tube about 2 1-2 feet in diameter was lowered from the side of the scow into the deposit and worked down until it passed through the ore layer into the sand beneath; then, by means of an implement like a telegraph spoon and by long-handled tongs and grappling irons, all the ore within the area of the tube was brought up to the deck of the scow, where it was examined and

*From *The Engineering and Mining Journal.*

weighed. This was done at several points in each deposit, and having already determined the extent of the deposit it was an easy matter to estimate the ore in sight in each.

By this method it is believed that a very reliable estimate of the quantity of ore in the lake was obtained ; certain it is that the estimate made by the writer differs materially from those that had been made by other means. It must be added in conclusion, that this lake-mine is something like the widow's cruse of oil of which we read in Holy Writ—the supply is being constantly renewed. Vast amounts of iron still exist in the surrounding sands. Vegetable acids are formed from the decay of each year's vegetation, and each year the drainage carries into the lake and deposits there a large amount of iron. This is no mere theory ; one can actually see the deposition of the ore along the margin, and, moreover, it is found in actual working ; if a certain spot be worked out it will in a few years again yield ore in paying quantity.

## HOW TO MAKE A SIMPLE STEAM CALORIMETER.*

BY M. THOMAS FULLAN.

In these latter days of keen competition, it is desirable to take every advantage, and to correct all sources of loss from whatever cause. The fact that many boilers, particularly when forced or overworked, produce wet steam, is well known, but the amount of this moisture, or even the fact of its existence, is not always easily determined.

Many engineers have not access to the expensive instruments for determining the same, and in view of this last fact, I herewith submit a short description, with sketches, of a very simple "throttling" calorimeter, which any engineer may construct for himself, at the nominal expense of a few pipe fittings and a steam thermometer, which may be purchased for a couple of dollars.

Fig. 1 shows the calorimeter assembled in position for use, connected to a steam pipe; when possible, it should be connected to a vertical pipe, as shown. The body of the instrument may be made of a 1-inch T fitting, into the top of which is screwed the bushing, *B* (Fig. 2) ; into the bushing, *B*, is fitted the thermometer tube, *T*, which is made of brass, turned down, as shown, sufficiently thin to readily

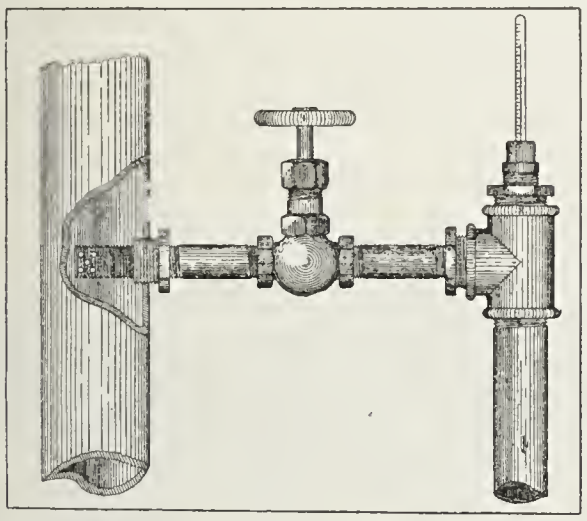


FIG. 1.

transmit heat, and the mouth of the tube is somewhat cupped. The steam pipe *S*, made of ½-inch pipe, is threaded sufficiently long, so that after having been screwed into the bushing, *D*, it will accommodate a ½-inch cap, *C*, which is screwed on the end, making a steam-tight joint with the bushing, *D*. Into the centre of the cap is drilled a small hole, about $\frac{1}{16}$ inch in diameter, countersunk on both sides, the function of which is to "throttle" the steam.

Care should be taken in obtaining, as near as possible, the best specimen of steam in the supply pipe, so it is advisable to connect up, as shown in Fig. 1, by inserting the feed pipe, *S*, the end of which is perforated, into the centre of the supply pipe. If it is simply screwed in, as is ordinarily done, some of the condensed steam, which invariably exists, would, in trickling down the side, enter the calorimeter and cause an error. The exhaust pipe, which leads from the bottom of the instrument, may be of any convenient length. Fig. 2 shows other views of the thermometer tube and throttling nozzle.

This type of calorimeter, termed "throttling," was developed by Prof. R. C. Carpenter, of Cornell University, and the principle upon which it operates is as follows :

Some of the heat contained in high pressure steam is liberated when the pressure is lowered, and that heat is utilized in evaporating any water the steam may contain, and in raising the temperature of the steam above that due to its pressure. Thus, for example, the total heat in 1 lb. of steam at 80 lbs. absolute pressure is 1,177 B. T. U. (British Thermal Units), and that in 1 lb. at 20 lbs. absolute pressure

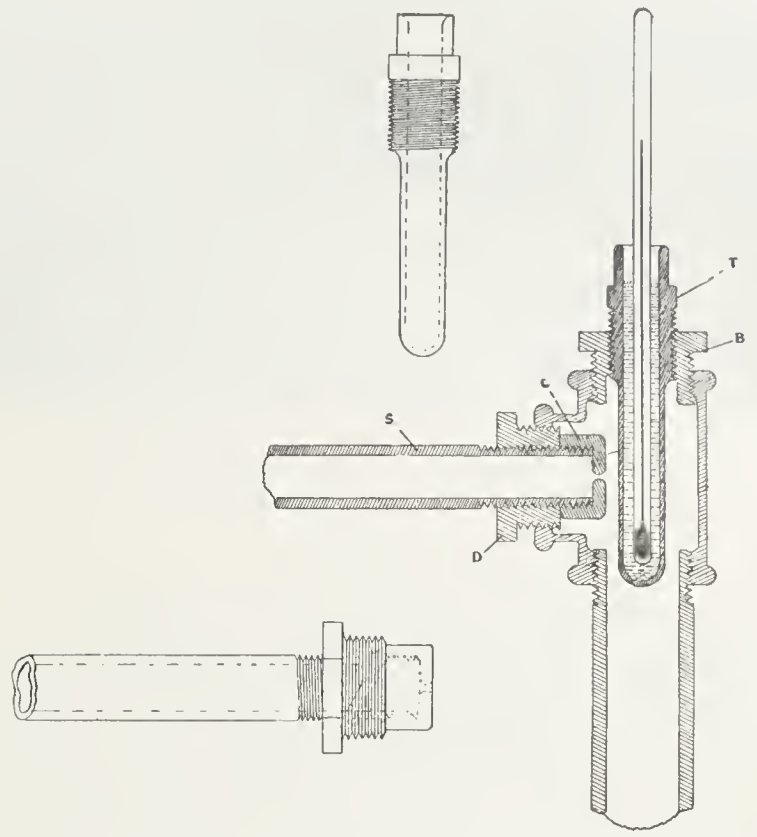



FIG 2

is 1,151 B. T. U. If, now, steam were allowed to expand without doing work on any body except itself, from 80 lbs. to 20 lbs. pressure, 26 B. T. U. would be liberated for each pound of steam. Since, at 20 lbs. pressure 954 B. T. U. are required to evaporate 1 lb. of water, we should have additional heat sufficient to evaporate 26÷954, or .027 lbs.

Now, if the original steam contained less than 2.7 per cent. of moisture, a thermometer placed in the steam would show a temperature higher than that due to a pressure of 20 lbs., which is 228° F. In such a case it would be possible to compute the percentage of moisture in the steam ; but if the steam contained more than the above percentage of moisture, the heat would not be sufficient to evaporate it, and the reading of the thermometer would be equal to that of the boiling point of the given temperature ; thus no computation of the moisture contained in the steam could be possible. That is, a throttling calorimeter cannot be used if the steam contains much over 2.5 per cent. of moisture, but it is very convenient and accurate within its limits of operation.

To operate the instrument, connect up as shown and fill the thermometer tube with some heavy oil, cylinder oil probably being the best. Now, having inserted the thermometer, open the valve and allow steam to flow until the temperature has become constant, which will be but a short while ; when the conditions are such, read the thermometer, the operation then being complete.

The quality of the steam may be then readily found by substituting in the following formula :

$Q = [H - S + .48\ (T - 212)] \div L$, where $Q$ = quality of steam ; H = total heat at atmospheric pressure ; $S$ = temperature of steam in boiler at absolute pressure (gauge pressure + 14 7 lbs.) ; $T$ = temperature observed in calorimeter, that is, reading on thermometer ; $L$ = latent heat of steam in boiler at absolute pressure.

Values of $H$, $S$ and $L$, may be found by consulting steam tables found in all mechanical handbooks, and are also furnished gratis by some builders of boilers. The percentage of moisture is, of course, $100 - Q$.

## SAFETY VALVE PROBLEM.

In our July issue we printed a solution of a safety valve problem in which the weight required on the lever was incorrectly stated. The conditions were : lever, 36 inches ; diameter of valve, 3 inches ; fulcrum, 3 inches ; pressure 125 lbs. The required weight on the lever is 73.625 lbs. The formula for solving such problems is :—

Area of valve = A = 7.068.
Length from fulcrum to weight = L = 36″.
Length from fulcrum to valve = l = 3″.
Weight of ball = W.
Load on safety valve = area × pressure.
Steam pressure = 125 lbs. = p.
Weight of valve and lever not taken into account.

$$W = \frac{A \times p \times l}{L}$$

$$W = \frac{7.068 \times 125 \times 3}{36}$$

$$W = 73\ 625 \text{ lbs.}$$

* From the *American Electrician*.

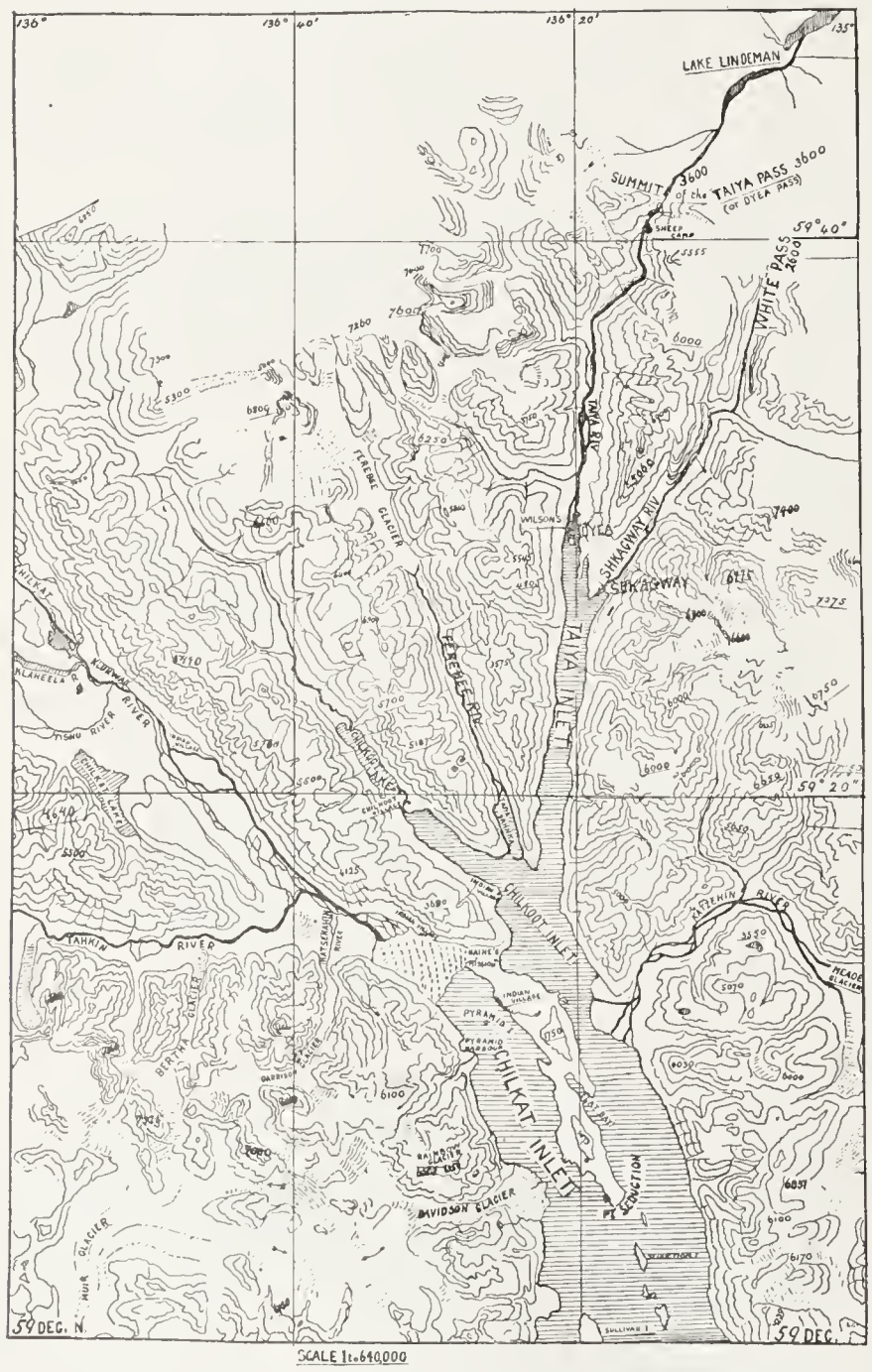
From a mountain 6,250 feet high between Davidson and Rainbow Glaciers, looking northerly.

From a mountain 6,250 feet high near Davidson Glacier, looking N. E. towards the mouth of the Katzchin River.

A PANORAMA OF THE INLET I

## THE CANADIAN YUKON GOLD FIELDS.

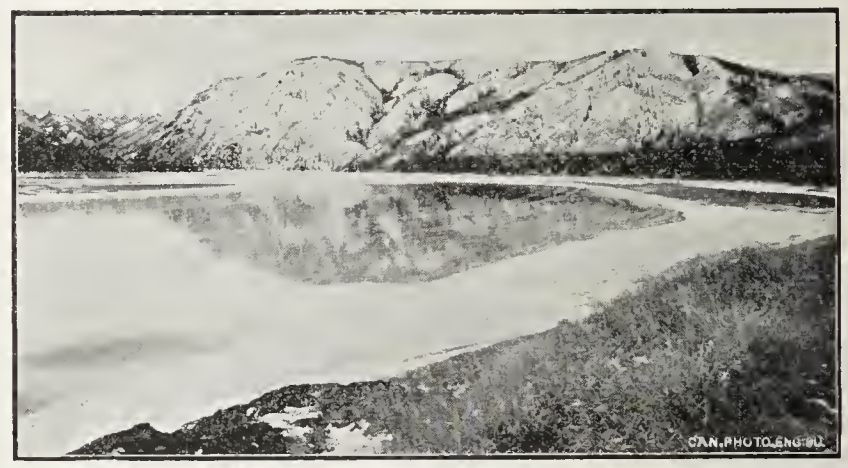
The London *Punch* published the other day a cartoon on the Klondike which will not be very comforting to those whose friends have already started for this world-famous region. It depicts a mountain with a shining golden summit. Death, accompanied by ravenous wolves and a polar bear, sardonically watches the struggling climbers. The one nearest the bear is already exhausted, and those behind him are appealing, without hope, to the gold which has become to them a god. Such a picture will serve a useful purpose in making the grapes seem sour to those whose poverty or delicacy prevents their attempting the enterprise, and also as a powerful hint to those whose capital of coin and iron constitution promise certain success.




SCALE 1:640,000

The Dominion Government has energetically taken up the task of regulating the mining operations of the Klondike and the improvement of the means of transport, etc., is engaging its earnest attention. One of the most important operations is the survey of the White Pass—the easiest route from Dyea or Shkagway. This is being done by C. E. Carthside, a civil engineer of Juneau, and six assistants, at the instance of an English syndicate which intends to run a railway from Shkagway, a few miles from Dyea, to the Hootalinqua River, a distance of 110 miles. The highest altitude to be reached is the summit of the Pass, 2,600 feet, about 20 miles from Shkagway, where wharves and warehouses are to be built. This surveying party has been at work since the 28th July, and is already twelve miles up the river. The work is to be pushed on so that the line will be completed as far as Taku Arm next year. At present this pass, though the easiest, presents terrible obstacles, and it is so difficult to get horses over it that the track is dotted with baggage abandoned until a more favorable opportunity arrives for its carriage. But a line even to Taku Arm will considerably lessen the difficulty and land the miner near a waterway which is navigable for miles at a stretch through the Teslin and Lewes Rivers into the Klondike itself at Fort Selkirk.

Many other schemes are being talked over, such as transport cables, etc., and meanwhile a force of about 1,000 miners who are obliged to wait for a favorable opportunity to transport their baggage, are at work on the trails with pick and dynamite preparatory to the work of the shack builders and trail makers sent out by the Government. In addition to this, new steamship companies are incorporated almost daily. The North-West Trading and Transportation Co. has just let a contract for three more steamers which are to ply the Yukon between St. Michaels and Dawson City. That means that this company alone will have eight steamers on the Yukon. Up to the present, navigation has been very difficult, but a company of New York capitalists is building a gigantic dredge capable of removing about 900 tons of sand or gravel per day. And this is to traverse the Yukon and render navigation as easy as if on the busy waterways nearer home.




LOOKING DOWN THE YUKON FROM OGILVIE'S OBSERVATORY.
From a Photo by Capt. Deville, Surveyor-General.

In the holding of a claim, might is still right, but the might of the individual is now substituted for that of wise government regulations and protection. Inspector Constantine has been for some time acting as commissioner in the Klondike, empowered to fix the limits of all claims and report them officially. Until the arrival of the new administration he is acting in a semi-judicial capacity and settles all disputes under the direction of the Government at Ottawa. This primitive arrangement was not, however, intended as permanent, and Major Walsh, of Brockville, has been appointed as administrator of the district and commander of the Mounted Police. The major's qualifications and the popularity of his appointment have received so much attention from the daily press that it is unnecessary for us to add anything on that head. The new administrator does not at present intend to hold his office for a long period, but he will see the territory in thoroughly good working order before he returns to his home in Brockville. Lieut.-Col. Henry Aylmer, of Winnipeg, was appointed as clerk of the court and registrar. He has since resigned that post, but there is no lack of applicants, and the office will be filled by some other qualified person. The Minister of the Interior has decided

From a mountain 6,350 feet high between Davidson and Rainbow Glaciers, looking east towards Point Seduction.

From a mountain 6,250 feet high between Davidson and Rainbow Glaciers, looking S. S.-E. down Lynn Canal.

From Photos by W. F. KING, Chief Astronomer to the Dominion Government.

## G TO THE KLONDIKE PASSES.

to accompany the major and his party as far as Tagish, so as to inspect for himself the facilities for landing passengers and traffic, and conveying them over the summits of the passes. In order to keep the balance of justice in case of differences or crime, Judge McGuire, of Prince Albert, has been transferred to Dawson City, where his court will be held. A gold commissioner has been appointed to take over some of the duties hitherto performed by Inspector Constantine, and has power to make such regulations as his experience proves necessary for enforcing the law on placer mining, and a force of eighty Mounted Police, with a Maxim gun, are already on the way. This force is likely to be increased to 125.

The arrangements for the carrying of mails are nearly complete. This has been done by the friendly co-operation of the Canadian and American Governments. The latter Government will carry the mails free from Victoria to Dyea, when they will be handed over to the Mounted Police, and the Canadian Government undertakes that the mail shall be carried once a month between Dawson City and Dyea, Both these cities will be declared International Postage Exchange offices. There are already post offices at Dawson City, Fort Cudahy, and Forty Mile, and others will necessarily follow. This arrangement is to be supplemented by the work of a Government commission consisting of an astronomer, surveyors, geologists, and telegraph experts, part of whose business will be the establishment of telegraph communication between the various important points and telephone lines between the principal mining camps. That so much has already been done for a hitherto almost inaccessible district in the interest of human life and comfort, affords a strong presumption that ere long the only deterrent will be that of the climate, and even that is in some measure subservient to the advances of industry and civilization.

Both Dawson City and Shkagway are assuming the appearance of municipalities. Late last year the inhabitants of Dawson City numbered 4,000, and Mr. Ladue, who owns the site, estimates that next June it will have run up to 25,000. It may not, of course, remain at that figure; but a residue of the miners, and the certain increase of stores of various kinds, will make Dawson a very considerable town. Already it has a saw mill and Presbyterian, Baptist, Methodist and Roman Catholic churches. It is the headquarters of the Mounted Police, and the Government intends to establish a bank there, where the gold of the miners can be deposited and exchanged for drafts. This will, of course, necessitate the establishment of an assay office. Shkagway has already a Broadway and several avenues, and many of the miners are locating lots and building houses. It is estimated that next year its population will reach 5,000.

The number of edible vegetables and fruits that can be grown in the region is larger than at first supposed. Wild onions, rhubarb, blueberries, cranberries, salmonberry, wild raspberries and red currants grow in abundance on the sides of the mountains, and the Department of the Interior has just received from Mr. Ogilvie a bunch of wheat bearing the following card: "Grown at Fort Cudahy from accidental planting in the autumn of 1895. All from one root and cut 14 inches above ground, Sept. 7th, 1896." August 27th, min. temp, 31 8; August 31st, min. temp., 27.2; Sept. 1st, min. temp., 27.6, The wheat is not of the highest grade, but it is good nourishing grain.

The severe cold for so many months in the year seems to present the greatest ultimate difficulty, but Mr. Ladue says he has chopped wood in his shirt sleeves when the thermometer registered 70 degrees below zero and suffered no inconvenience.

Judge McGuire, who will preside over the courts of the Yukon district, was formerly a partner of the late James O'Reilly, in Kingston, and has for about twelve years been one of the judges of the Supreme Court of the North-West Territories.

A. E. Mills has gone from Victoria to Lake Teslin to erect a saw-mill there for F. M. Yorke, who also contemplates building a steamer on that lake.

A report from Lake Lyndeman, dated last month, says there are about 400 men on that lake and Lake Bennett building rough boats in which to descend the river to the Klondike mines.

NEAR THE HEADWATERS OF MILLER CREEK, YUKON DISTRICT.
From a Photo by Capt. Deville, Surveyor-General.

James D. McGregor, of Brandon, has been appointed inspector of mines for the Yukon, and is on his way to the Klondike.

On the authority of Hon. James Orr, the first member for Cariboo in the crown colony parliament of B.C., and John King, a Spokane miner, the B.C. *Mining Journal* gives the following as an easy pack route: Ashcroft to Quesnelle, 220 miles; Quesnelle to Fort Fraser, 140 miles; Fort Fraser to Decker Lake, 30 miles; Decker Lake to Hazleton, 75 miles; Hazleton to Kispiox, 9 miles; Kispiox to Stickeen above canyon, 90 miles; Stickeen above canyon to Teslin Lake, 120 miles; total, 684 miles, with good feed from the first of May until fall all the way. At no point is there a stretch of more than 20 miles without good feed. For hundreds of miles peavine is found in profusion, and blue joint stands along the lakes and water courses higher than a man on horseback in places. There are no high divides to cross, and good roads could easily be made from Quesnelle to Lake Teslin, on which route fresh horse feed can be had in plenty from 1st May to 1st November. The Hudson Bay Company turn out its "cayuses" all winter, and in the spring they are fat. They paw up the snow and get at the grass. In Lake Teslin salmon are captured weighing as much as 40

pounds. Grouse and pheasants are sometimes got, but the great game bird is the ptarmigan, of which countless thousands may be shot. The climate is not bad, and Mr. King knows families of white people who have lived n this route for 30 years and reared children. He says: "The man who goes to the Klondike by this route is exposed to few more hardships than in any new country. He can go nearly every foot of the way on train, steamer, horse and small boat. Once at the head of navigation, the man with an outfit can employ Indians to do the drudgery of camp life and will be sure of safe pilots. The Indians, Taltons and Stickeens get $2 a day and board. They do the cooking, set up the camp and perform all other duties." It may be added that this route, as far as Telegraph Creek, has been used more or less ever since the days of the Cassiar alluvial mining days of 1870, and has been traversed by thousands of miners. Reports by the Government geologists show that all the regions bordering on this route are highly mineralized, and generally speaking have been scarcely touched on by the prospector The Canadian Pacific are now building a telegraph over this route. The line starts from Quesnelle, on the main line, and runs north-westerly to Fort Frances, thence to Hazleton, then to Telegraph Creek, then to Lake Atlin (from which a branch will run down to Dyea), and from there to Fort Selkirk and Dawson City.

It is safe to say that the world will know more about the great North-West of Canada in the next six months than it has known in the past sixty years. By each steamer newspaper correspondents are going north from Victoria, and from San Francisco, and Seattle, representing not only the leading Canadian papers, but American and European publications, including such papers as *Harpers'*, of New York.

A man named Johnson has come down to Vancouver with his partner, bringing $18,000 as the result of a strike this season on the Peace River, where they had been for three months working with pans and 12 foot sluices. Other miners were remaining there all winter, depending for their supplies on the H. B. Co.'s boats, and were taking out large quantities of gold with the crudest appliances. Owing to these finds it is proposed to organize a company, which will put new steamers on the Athabaska and Peace Rivers. The question of the route to the Yukon by these rivers and the Mackenzie is well treated in Edmonton *Bulletin* of Aug. 12th, in which two routes are considered cheap and practical, one being by way of the Pelly and the other by the Porcupine branches of the Liard River, starting from Athabaska Landing. These routes have already been taken by a number of people from the North-West Territories. The distance from Edmonton to the Klondike is 1,400 miles as against 1,600 by the Chilkoot Pass and 4,400 by Behring Sea. A surveyor who has been over the route says one difficulty is the time lost in ascending the Yukon to the Klondike after going down the Porcupine, but such points will soon be determined; but meanwhile it may be said in favor of these routes that the discoveries of gold and other minerals this side of the Yukon—such as noted above—will render them attractive to the prospector. There may be more than one Klondike in the vast area of utterly unexplored country accessible from these routes. We can quite agree with the *Bulletin* that an all Canadian, all-land route, affording access to the north at all seasons, is the most pressing necessity if the wealth of this region is to benefit the trade of Canada.

W. T. Jennings, the well known civil engineer of Toronto, is at the head of an exploring party whose mission is to determine the best route for a railway to the Klondike. Mr. Jennings is now reported on his way to the Stickeen. Meantime, an American party under W. A. Pratt, of Wilmington, Del., is projecting a railway for an American company.

The Alaska *Mining Record* has compiled a list of the amounts brought down by the miners during the present year, the total, including miscellaneous small finds, making over $6,000,000. The steamer "Portland," on her latest trip down to Seattle, brought gold-laden miners whose "piles" amount to a total at first estimated at $3,500,000, but which afterwards proved to be $575,000. Some of these returning miners declare that the half has not yet been told of the riches of the Yukon district. A party has returned to British Columbia, reporting strikes on and around a creek near Klondike amounting to $160,000, but the finders are not disposed to give particulars. The most important information to hand since last issue is that brought down by Mr. Ogilvie, the Government surveyor, now on his way to Ottawa. He is reported to have made the calculation that 180 claims now worked on the Eldorado, Bonanza and Hunter's Creeks will, in three years, at their present rate of production, yield $70,000,000.

The London *Times*, in an article on the Klondike, says it is not easy to overrate the importance of the gold discoveries, which will prove a great incentive to the colonization of the Canadian North-West, because of the supplies of foodstuffs, etc., demanded by mining operations, and the fact that thousands who go out to mine will remain to settle on the lands. It was so in California, in Australia, and in South Africa, and will be so in Canada.

The Victoria *Colonist* mentions the following facts: In 1880 John McKenzie, a Canadian, with a party of Canadians, went down the Lewis River to Lake Lebarge. He was the first white man to run the White Horse rapids. He may be said to have discovered the route into the Yukon valley. The first discoverer of gold and mineral on Stewart River was a man named Fraser, from Nova Scotia. Franklin Gulch and Forty Mile Creek diggings were discovered by three Canadians named McCue, Stewart and Franklin. Davis Creek was discovered by a party consisting of one Canadian and four Americans. Miller and Glacier Creeks were discovered by a party consisting of Canadians and Americans. Birch Creek was discovered by a party consisting of three Canadians and two Americans. Klondike was discovered by a Canadian named Henderson.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The eighth annual convention of the Canadian Association of Stationary Engineers was held on the 19th and 20th August in the City Hall, Brockville, Ont. The first morning (Thursday) rain damped the hearty spirits of the delegates and put Brockville, as the entertaining city, at a great disadvantage. As a result the day's session was more fruitful in hard work than any other day in the history of the Association.

The delegates met about nine o'clock, and although seriously intent on work, about half an hour was spent in amusing reminders of the last convention. One incident was the presentation of an axe to President Devlin by Ald. McCrady. This had, no doubt, some timely significance, and though not on the programme, it evidently could not be described in the ordinary platitude as "a surprise to all concerned." The members were called to order at 9.30, and Ald. McCrady introduced Mayor Downey, of Brockville, who said he was pleased to have the privilege, as Mayor, of welcoming the engineers to Brockville, because he found that the objects of the association were praiseworthy. He continued: "If we look at any of our great factories, with hundreds of skilled operatives, guiding and directing machinery of many different kinds, which is driven by power derived from one central source, or at the waterworks or electric light system of a great city, we shall find the steam engine the source of all the power, controlled and regulated by a faithful and energetic man, on whose skill and integrity the successful operation of the whole elaborate system depends. How important then that the engineer should be a competent and trustworthy man, thoroughly skilled in all his duties, and I congratulate you and the public that your association devotes its energies towards securing the attainment of this most desirable end."

Then calling attention to the advantages of the town he said: "We have extensive manufacturing and other business establishments amongst us and also those various municipal improvements which mark a progressive nineteenth century town. Besides having an excellent system of water works and sewerage, our town is lit by gas and electric lights. We have commenced putting down granolithic sidewalks, and are looking forward to an electric street railway in the near future," and concluded: "Gentlemen, once more I welcome you to our town and invite you to feel at home in our midst, and I do most sincerely trust that your stay amongst us will be both pleasant and profitable, and will mark a step forward in the history of your association."

President Devlin thanked the Mayor on behalf of the delegates, said they would be pleased to welcome the Mayor and aldermen to any of the sessions, and invited the Mayor and Council to join the water party in the afternoon. Brief addresses then followed from the aldermen present.

After a few words from President Devlin, the Mayor and Council retired and W. F. Chapman read his address of welcome on behalf of Brockville, No. 15.

### ASSOCIATION'S WELCOME.

Mr. President and Brethren:

On behalf of Brockville Subordinate Association, No. 15, C.A.S.E., it affords me a great deal of pleasure to extend to the Executive Council and delegates of the Canadian Association of Stationary Engineers, at this their eighth annual convention, a hearty welcome to our town. This is the first time that Brockville has been honored with a visit from the representatives of the large army of stationary engineers in the Dominion, and I trust that your brief sojourn with us may be both profitable and enjoyable, and that when you return to

your homes you will bear away with you pleasant recollections of the Island City of the St. Lawrence and of its people. While this association partakes largely of the character of a mutual improvement society, its chief object being the educating of its members to a higher standard of excellence in their work, still it is not without its social side, and the development of the latter along proper lines tends much towards the achievement of success in the former. During the eight years of the association's existence, excellent progress has been made, and the highly satisfactory results testify to the necessity that existed for such an organization which would bring together men engaged in the same occupation for fraternal intercourse and consideration of matters of interest to all. No one man knows it all in any one line of business, and it is only by free discussion and interchange of ideas that the safest conclusions are arrived at, and the best results are achieved. The position of the stationary engineer in Canada has greatly changed during the past few years. Previous to that time every man was working away along a line of his own, and knew little and cared less for what others around him were doing. Now this is all changed. At the meetings of our association difficulties which individual members meet with in their daily work are presented and discussed, and it is a knotty problem indeed for which a satisfactory solution is not found. In this way a large amount of theoretical knowledge is gained, which, added to the practical experience already acquired, makes every one who listens to or takes part in the discussion a better man. It is necessary to keep abreast of the age in which we live, and nothing helps more in that direction than frequent interchange of thought and close attention to what is going on in the world around us. While the members themselves thus reap a great advantage, their employers are also benefited, and much trouble and expense are often averted by the engineer knowing exactly what to do when a difficulty arises. In this way the association has begun a good work, which it is hoped it may long continue to carry on. Again, on behalf of the association I represent, I bid you welcome to Brockville, and extend to you the freedom of the town during your stay with us.

The roll was then called, the following members answering:

Toronto, No. 1—G. C. Mooring, James Huggett, Chas. Mosely, A. M. Wickens.

Montreal, No. 1—J. J. York, J. G. Robertson.

Hamilton, No. 2—Robert Pettigrew, Geo. Mackie.

Stratford—W. G. Blackgrove, John Fox.

Brantford, No. 4—Thos. Pilgrim, A. Ames.

London, No. 5—G. B. Risler, Wm. Gerry.

Ottawa, No. 7—Thos. Wensley, F. J. Johnston.

Dresden, No. 8—T. M. Steeper, Wm. Jameson.

Kingston, No. 1—C. Selby, F. Simmons.

Kincardine, No. 12—Jos. Walker, Percy Ashton.

Wiarton, No. 13—J. F. Cody, Ed. Dunham.

Peterboro, No. 14—Fred. Donaldson, John Morency.

Brockville, No. 15—F. P. Andrews, C. Wilkinson.

Carleton Place, No. 16—Hugh McKay, W. J. Griffith.

Waterloo, No. 17—Chas. Uttley, Fred. A. Pflug, together with the Executive officers. District Deputies Granberg and Cody were absent. The following committees were then appointed :

Credentials—J. Huggett, Toronto; C. Selby, Kingston; Nathan Uttley, Berlin.

Constitution and By-Laws—J. J. York, Montreal ; G. B. Risler, London; A. M. Wickens, Toronto.

Mileage—Jos. Robertson, Montreal; G. C. Mooring, Toronto; F. M. Steeper, Dresden.

Good of the Order—F. Simmons, Kingston; C. Mosely, Toronto; J. McKay, Carleton Place.

A lengthy discussion then took place on J. J. York's suggestion that the associations admit to every meeting bona-fide steam-users. Many employers seemed to think the C.A.S.E. was a labor organization, and to remove this error, he suggested that an invitation card containing the subject of the paper and name of reader be sent to steam-users every month.

President Devlin then read his opening address as follows:

I have the honor to welcome you to this our eighth annual convention. I am aware that in selecting you as delegates our various branches have sent their best men, consequently I am confident that your deliberations will result in the advancement of our organization, and that in dealing with the various subjects brought before you, the one and only aim sought shall be the greater good of the C.A.S.E. I am sure that naught but good-will shall prevail; indeed, such is one of the cardinal principles of our order. I need not ask for your hearty support, as this has always been given to the occupant of this chair. The committee appointed to act jointly with the C.A.S.E. to draft a bill seeking from the Dominion Parliament a law compelling engineers to pass an examination and hold certificates of competency, met in Toronto on March 17th last. The result of the deliberations and a copy of the bill will be laid before you. As you are aware, the bill received two readings in the House of Commons, and I am assured by the delegates who had charge of the legislation at Ottawa that, were it not for the lateness of the session, there would have been every prospect of the bill becoming law. The thanks of this association are due James Sutherland, M.P., for the kind reception of our delegates, and for his earnestness in endeavoring to have the bill become law. In this connection I should say that in this movement not only are the members of our association a unit in favor of such a law, but, I might add, almost all the qualified engineers of this country are with us, as well as most of the manufacturers and steam-users. During the past year some of our branches which had for some years shown want of vitality have been resuscitated. They are now possessed of fair membership, active and diligent in the work of the order, educational and social. London particularly is doing good work. On the whole our membership, however, shows a slight increase this year over last year. Guelph and Stratford, I am sorry to say, are not in a prosperous condition, and some effort must be made to infuse new life into these tardy branches. During the past year I can only report the establishment of one new association, that at Waterloo, Ont. It is to be hoped that during the coming year more advancement will be made in this regard. However, whilst our membership may not have materially increased in numbers, there has been greater care exercised in the selection of members, and the principles of the order have been most rigidly adhered to. I am most pleased to know that in some of the lodges the work is done with great precision, the use of the book of ritual being dispensed with by many of the presiding officers. The educational work, the great feature of the organization, goes on with greatly increased vigor and benefit to the members. During the year I had the pleasure of attending meetings at our two great centres, Montreal and Toronto. In both I was struck with the material progress visible and the facilities available to members by way of books, models, etc., whereby the educational benefits, so invaluable and important, are advanced. This feature of our association's work cannot be too highly appreciated. It may be necessary at the present convention to again take up the matter of bi-annual conventions, with a view to the curtailment of the expense necessary for an annual meeting. Steps should also be taken to arouse the engineers of the Dominion to the loss they sustain in not being of our membership. The provision made at last year's convention for the issuing of certificates of membership has been carried out. The matter of getting up a hand-book souvenir from which we expected to realize sufficient funds to meet the expenses of the convention has not taken practical shape, consequently, for this year at least, our old sources of revenue will have to be relied upon. Our worthy secretary and myself have been in correspondence for some time past, and he will lay before you very important information on the subject, which will be of great value when the postponed work is again taken up. Difficulties and persecution which I have encountered in common with others in the same employ have rendered it impossible for me during the past seven or eight months to give the active work to the accomplishment of the souvenir scheme which I had wished. Brethren, in conclusion, I desire to express to you my deep sense of gratitude for the great honor you conferred on me a year ago when you elected me to the high and honorable position of president of this association, and for the loyal manner in which you have stood by me. In closing, I will only add it is my heartfelt wish that your deliberations at this meeting may be so conducted towards each other that everything we shall do will redound to the benefit and honor of our good association.

Secretary Chapman then introduced W. H. Comstock, who offered the delegates the use of his steam yacht for a trip among the Thousand Islands. President Devlin tendered the hearty thanks of the convention to Mr. Comstock, and hoped he would allow them the privilege of electing him an honorary member, which was done.

The weather was so bad that the trip was postponed until

the next afternoon, on the understanding that the rest of the day be devoted to business.

President Devlin then announced an invitation from R. A. Bush, chairman of the Entertainment Committee, to visit the Brockville Asylum, of which he is chief engineer. This was declined owing to pressure of business.

An adjournment was then proposed by J. G. Robertson, seconded by W. G. Blackgrove, and carried.

The convention met for the afternoon session at 1.30. The appointment of auditors was the first business. They were J. Robertson, Montreal; F. Donaldson, Ottawa; Geo. McKay, Hamilton; F. P. Anderson, Brockville.

The report of the Committee on Credentials was presented and adopted.

Report of the Committee on By-Laws: J. J. York did not think it necessary to present a written report, as the articles permitted all that had been proposed with regard to hon. members.

J. Robertson asked: Is the C.A.S.E. incorporated? No? Well, the sooner the matter is taken up the better.

Vice-President Philip: Toronto, No. 1, was incorporated with power to appoint other associations. Toronto, No. 1, transferred all its powers to the Executive of the C.A.S.E.

J. Robertson: That is not the idea.

A. M. Wickens: The corporation was first called the C.A.S.E., and the present lodge is said to be located in Toronto. After running a year or two Toronto turned over her power to the C.A.S.E., and payment was made for all disbursements made by Toronto. He agreed that the C.A.S.E., as we now know it, should be incorporated, so as to act equally and legally in every province. Under a Dominion Act this would cost some $200, while the local Act cost $23.

J. Robertson: Montreal is incorporated under the laws of the Province of Quebec, but still it is local. Now the simple act of Montreal turning over its power to another association does not mean that the other association is incorporated.

Vice-President Philip: In asking for incorporation you have to state the names of those composing the proposed corporation, and the place where the office is. But fifteen minutes after incorporation you can change the personnel. This is all that was done by Toronto, No. 1. However, a Dominion Act would be better.

Jno. Murphy: When the C.A.S.E. was formed it took over the charter and seals of Toronto, No. 1. That charter is in the possession of the C.A.S.E.

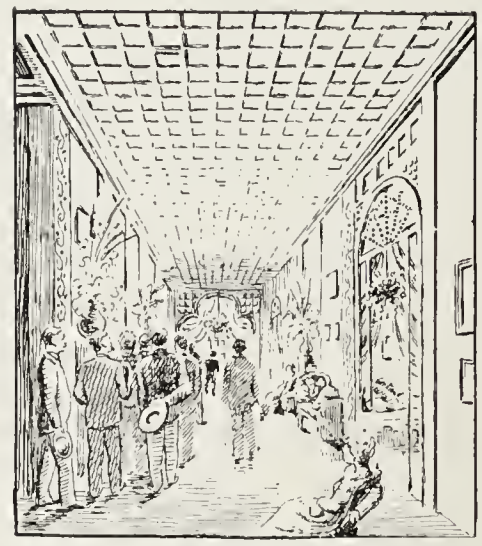
J. J. York: When I was Executive secretary, I made an attempt to draw a line between Toronto, No. 1, and subordinate associations. I never saw a charter of any description—nothing but the blank lithographed form which is filled in for subordinate associations. There was no seal until I got one made. I never heard of a sealed charter.

At this point Ald. McCrady entered and said that as the weather seemed to be settling for fine, he would procure rigs to take the party to the asylum, if it were agreeable to them.

C. Mosely proposed, and J. Robertson seconded, that all reports be deferred till the next day.

President Devlin then made a few remarks respecting legislation. He had not yet heard from the delegates, but it was said that opposition was coming from Quebec. The delegates from Quebec are here, he said, and the delegate to the Ontario Government (A. M. Wickens) is also present. A. M. Wickens said that at the second reading of the bill there was a strong opposition by the French members. He strongly advocated a Dominion law. Chas. Mosely suggested that this matter be left to the Committee on the Good of the Order. F. Simmons moved that J. J. York and J. Robertson, of Montreal, and A. M. Wickens, the deputy to the Ontario Government, be added to the Committee on the Good of the Order. This was seconded by C. Mosely and carried.

The convention then adjourned for the trip to the asylum. The party drove past Brockville's most beautiful homes, some of them belonging to men whose names are known to the English-speaking world. One of the most charming was that of Major Walsh, who within a few days will start for the rigorous Klondike region, there to exercise the function of Governor over a hoard of sturdy men such as only a mining boom can gather together. The party was received at the Asylum for the Insane by Dr. Murphy and staff, and conducted round the wards by Ald. O'Brien. These wards are winning in appearance. They are constructed on a light, airy plan, and decorated with an elegance calculated to subdue all grossness and inspire a habit of placid contentment, as useful to the sane engineers as it was necessary to the deranged inmates. Notwithstanding the deep sympathy that was generally felt for those whose liberty was restrained for apparently so light a reason, the visit acted as a pleasant and wholesome pause to the hilarity which



CORRIDOR IN THE ASYLUM FOR THE INSANE BROCKVILLE.

belongs to the convention. After visiting the kitchen, laundry, engine-room and pumping station, and congratulating R. A. Bush on the condition of his boilers and machinery, the party drove on to the fire and electric light station. On the return to the St. Lawrence Hall, Ald. McCrady gave an alarm of fire. The fire station was a quarter of a mile away, but in the space of one minute 50 seconds the hose was throwing its full stream of water in front of the hotel and far higher than its roof. Snap-shots were taken by Vice-President Philip of the firemen, engine and horses, and they departed amidst the hearty cheers of the delegates.

The delegates gathered for the evening session at 7.30. Ald. McCrady introduced Ald. Cash, Thompson, and the chairman of the Board of Works, E. A. Buchman. F. Simmons presented the report on the good of the order, which proposed that the holding of the convention bi-annually be considered at this meeting. It recommended that a committee be composed of one man each from Toronto, London, Ottawa, Montreal, and Kingston, to take up the work of legislation, and carry it through without delay, and that these men be appointed by their respective lodges. It also recommended that the subordinate lodges be requested to create as many hon. members as possible from among steam-users. The discussion of this was taken up later on.

A. M. Wickens was then called upon for his paper on the C.A.S.E. He had not written a paper, but proceeded with an interesting address. He said in effect: One of the most vital things to the organization is to keep up the interest during the convention. The lodges should be well represented, and

"GRANDPA" ON THE C.A.S.E.

the programme of business adhered to rigidly. We ought to be making more rapid strides than we are doing. This association is unique in its general laws and working. The foundation is education and our mottoes are Safety, Economy, Re-

liability. It is purely an educational society, and the members spend their own money in educating themselves. An engineer can save his employer much money, and he is entitled to a share of that, and indeed, sometimes gets it. Since the object of the association is to educate engineers up to this point, we should leave no stone unturned to secure the membership of capable men, who are interested in the object. Too many men get interested for a time, and then fall out. He thought that the best way to secure interest in the general meetings would be to get live secretaries. Those who have acted have done their best, but it has been for love. Why not pay the secretary a little for his trouble? This would considerably strengthen his hands. There are 4,000 engineers in the Province of Ontario, but they are so scattered that it is difficult to get them together. Many of the towns have so few plants that there are not enough members to make a branch and rent a room. From the successes that we have made in educating young men we should naturally think that we have more good men in the organization than appear. It takes money to run a branch, and the secretaries are sometimes to blame for not looking after the subscriptions. Then the Executive secretary should keep in close touch with all the branches by writing to them every month and telling them of the progress made by other branches. We could start a set of questions to be sent to all the branches. An extra movement should be made this year to interest steam-users in the coming legislation. This could be done by inviting them to the local meetings.

As the papers to follow were likely to initiate discussions he would now give way to them.

G. B. Risler, of London, then read his paper on "The Use of the Indicator," followed by Vice-President Philip's paper on "The Use of the Tower for Condensing Purposes." Having finished reading the paper, Vice-President Philip added that he recently had the pleasure and profit of installing a cooling tower. When you have to buy water for feeding the boiler the cost renders it out of the question. Then the cooling tower is an advantage. One is used at O'Keefe's brewery. Water is pumped to the top of a tower, which has some filling, wood, tile, or wire, which spreads out the water in falling. The temperature is thus reduced, and the water can be used again. The process evaporates a certain amount of water, and this produces a reduction in the temperature of the surrounding air, which will condense another pound of water. The plant that he was most familiar with was of 500 h.p. capacity. It is a surface condenser. It has 6,400 ft. of tubing, and 1,600 stuffing boxes. The tower is 19 ft. high, and the filling is 11 ft. long. The water goes up at a temperature of 120 deg., and when it reaches the bottom of the tower it is at 68 deg. This is a subject of vital importance to engineers, for as the coal bill keeps creeping up, condensing is one of the best ways of reducing the quantity of coal.

W. F. Chapman: Is the plant expensive?

Vice-President Philip: The tower, piping and condensing cost $7,000. Where there is a yard a jet condenser can be used, and thus lessen the cost.

H. McKay: How long does it take to show the saving?

E. J. Philip: The saving is a net 15 per cent. on the coal bill.

H. McKay: What is the loss of water during evaporation?

E. J. Philip: There is an overflow of water from the top of the tower all the time. But with the cooling tower you can use less water than when not condensing.

J. Murphy: Is not a simple-acting pump much more economical than a duplex?

E. J. Philip: A simple-acting vertical bucket pump is, because the valves close so rapidly. The ordinary horizontal pump is the least economical.

J. Murphy had had some experience with both vertical and horizontal pumps. The vertical in these cases were under some disadvantage certainly, but he had more trouble with the vertical than with six or seven horizontal. His was a Blake condenser.

E. J. Philip: That must be an exceptional experience.

J. J. York hoped that in the near future Bro. Philip would let them have some accurate data on the saving. He did not at present see much saving. Manufacturers must see a larger saving than 15 per cent. before they would lay thousands of dollars in a plant. What is the chief injury to boilers using copper tube condensers?

E. J. Philip: The best evidence is that given by the British Admiralty reports on the British war vessels. The chief trouble was corrosion. In some boilers it eat out along the seams, and sometimes all along the boiler.

J. J. York said he used a great many copper feed pipes and never noticed any matter in the boiler.

E. J. Philip: Well, you don't get much copper piping now. It is not pure copper, and has much brass in it.

J. Robertson, on being asked for his experience with copper piping, said it was with a cooking apparatus run by a small locomotive boiler. He noticed that after two or three months the boiler began to pit. He concluded that the copper had something to do with it, so he run the water into the sewer and found no more pit. He asked would Bro. Philip use the condensing tower in the winter.

E. J. Philip: Yes. Though it is slightly more costly.

J. J. York moved, and J. Murphy seconded, a vote of thanks to the readers. This was adopted and conveyed.

The discussion on the recommendations of the Committee on the Good of the Order was then resumed.

Chas. Mosely proposed, and J. C. Mooring seconded, that the conventions be held bi-annually. J. Robertson sympathized in many ways with the proposal, but two years was too long. A quorum would not be obtained after so long an interval. J. J. York agreed. Each year the attendance is less satisfactory. As it is, there is not enough business done. It would be better to continue as they were. He was much in favor of a paid secretary with defined duties, for this very reason, C. Mosely moved and J. C. Mooring seconded, that the conventions be held bi-annually, unless the laws now before the Ontario Legislature be passed this session. Motion lost.

During an interval the Committee on Mileage presented their report. The actual sum expended was $191.55. The adoption of this report was moved by A. M. Wickens and seconded by C. Selby. The secretary's and treasurer's report showed the finances to be in a very healthy condition, having a larger balance than in any previous year. The adoption of this was proposed by J. C. Mooring, and seconded by J. Murphy.

President Devlin, who had returned to the chamber, proposed a vote of thanks to the Royal Oil Company, who had presented the C.A.S.E. with the sum of $10, per D. Reeves. J. Robertson then presented the auditors' report. Everything had been found satisfactory, and the book-keeping a credit to the organization. Its adoption was proposed by J. J. York and seconded by J. Huggett.

President Devlin then brought up the question of the souvenirs. This, it will be remembered, was to take the form

PRESIDENT E. J. PHILIP.

of an engineer's pocketbook. Letters were read by the secretary from two or three publishing firms who had been invited to tender for the same. E. J. Philip moved, and J. Murphy seconded, that this matter be left in the hands of the Executive, and that it is expected to have taken practical form by the next meeting.

J. J. York moved that the present secretary, F. W. Chap-

man, be tendered $25 for his services during the past year. This was seconded by J. Robertson, and carried.

The meeting was then adjourned till the following morning.

Friday.—The delegates gathered soon after nine o'clock. They had done good work the previous day, and this morning it was difficult to settle down. The first business was the appointment by President Devlin of the scrutineers, who were J. Fox, F. Robert, A. McCallum.

J. J. York then proposed that one ballot be cast for the office of president. This was seconded by J. Murphy, and E. J. Philip, of Toronto, was elected. By the same process F. W. Chapman, of Brockville, was elected vice-president, F. W. Robertson, of Montreal, secretary, and R. C. Pettigrew, treasurer. President Devlin nominated J. C. Mooring as conductor. J. Robertson nominated G. B. Risler. The ballot cast resulted in the election of G. B. Risler. J. J York nominated and J. Robertson seconded J. C. Mooring as door-keeper. He was elected without ballot.

The next place of meeting was then to be chosen. R. C. Pettigrew announced an invitation from Hamilton. J. Murphy proposed, and G. B. Risler seconded, that the invitation be accepted. W. G. Blackgrove announced the invitation of Berlin, and J. Robertson proposed London. The ballot resulted in the choice of Hamilton.

Conductor Murphy was then instructed to fetch in the caretaker, Michael Sullivan. On his appearance the president presented him with a $5 bill as a consolation for the trouble the convention had given him. The next business was the installation of the newly-appointed officers. A. M. Wickens was asked to act as grand conductor, and the most recent past-president, W. G. Blackgrove, initiated the officers, and presented each with the insignia of his office. On taking his seat President E. J. Philip, of Toronto, appointed J. Robertson, of Montreal, and W. G. Blackgrove, of Toronto, to act as district deputies.

Mayor Downey was then introduced, and after one of the little speeches, which ensured his popularity with the engineers, presented Past-President Devlin with a jewel of the customary design and value. Past-President Devlin returned thanks, and promised to devote himself to the interests of the association in the future, as he had done in the past.

J. Robertson then moved, and W. G. Blackgrove seconded, a hearty vote of thanks to the Mayor, Council and citizens of Brockville. The Mayor, in reply, said that he would be indeed a cold-hearted man who did not appreciate such treatment as he and the citizens had received. C. Selby proposed, and J. Murphy seconded, a vote of thanks to Ald. McCrady and O'Brien and other city officials.

P. P. Devlin proposed a vote of thanks to the local press of Brockville. A. M. Wickens, in seconding, said that at no convention had they received better reports.

Mr. Laidlaw, of the *Recorder*, thanked them, and said that if they ever returned to Brockville he for his part would be ready to repeat the operation.

J. Robertson proposed, and J. Murphy seconded a vote of thanks to THE CANADIAN ENGINEER.

J. Robertson moved, and J. J. York seconded a vote of thanks to the retiring officers.

The convention then adjourned to display itself before the photographer.

Afternoon.—At two o'clock the "Albani," Mr. Comstock's yacht, steamed out of Tunnel Bay with the engineers and their friends, accompanied by Mayor Downey and Councillors W. J. Wright and McCrady. The "Albani" ran up to Alexander Bay, where a stay of about half an hour was made. A plentiful lunch was provided on the return trip, after which a very hearty vote of thanks was tendered to W. H. Comstock, on the motion of A. M. Wickens and P. P. Devlin.

The party reached home about 7.15 p.m., and left the dock cheering the captain and engineer of the "Albani." The engineers then repaired to the Council chamber, where J. J. York proposed, and A. M. Wickens seconded, an expression of sympathy for A. E. Edkins, of Toronto, who was prevented by illness from being present.

A. M. Wickens proposed, and J. J. York seconded, a vote of thanks to the Brockville Association, coupling with it the name of R. A. Bush. Ald. McCrady briefly replied, and the convention proper came to an end. The delegates were then escorted by the Island City band and flambeaux back to the St. Lawrence Hall, where at 9 o'clock a dinner was tendered to the delegates by the Brockville branch.

Shortly after nine the delegates and their friends filed into the banquetting hall, and in all about 70 sat down. The Rev. J. C. Sycamore said grace. After the eating interval the toast list was entered upon.

The first toast was, of course, "The Queen," which was accorded the usual honors. The others were as follows: "Canada, Our Home," responded to by the Rev. J. C. Sycamore, ex-Mayor Derbyshire, and Town Clerk McMullen.

"Brockville, the Island City," responded to by Mayor Downey, Ald. McCrady and O'Brien.

"The Manufacturers," coupled with the names of Mr. Geo. Nicholson, of the James Smart Mfg. Co, and Bro. F. G. Johnson, of F. G. Johnson & Co., Ottawa.

"Kindred Societies," responded to by F. Lawrence, D. Reeves, W. J. Jento, and A. M. Wickens.

"The Executive" was replied to by P. P. Devlin, President Philip, Treasurer Pettigrew, Conductor Risler, and Door-keeper Mooring.

"The C.A.S.E." was responded to by J. J. York, W. G. Blackgrove, F. Simmons, F. P. Andrews, and Jno. Fox.

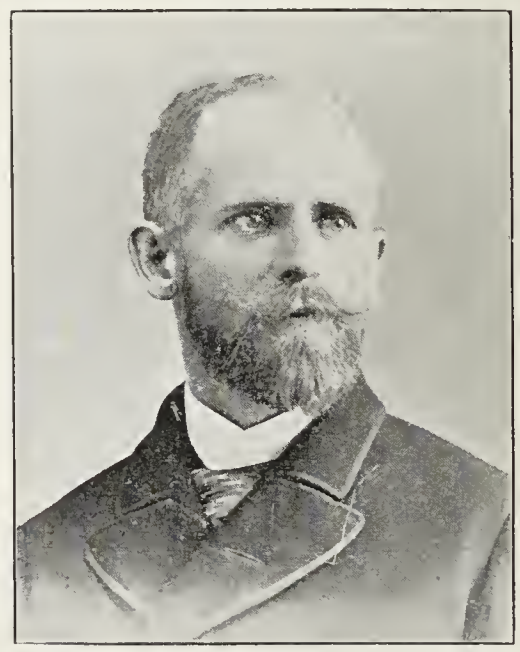
"The Press" was responded to by Mr. Spurrier, of THE CANADIAN ENGINEER; Mr. Healy, of the *Times;* and Mr. Laidlaw, of the *Recorder.*

"The Local Association" was responded to by W. F. Chapman.

"The Ladies" was responded to by J. Robertson, and "Our Host" by Horace Robinson.

Songs were contributed by W. G. Blackgrove, whose admirable voice would be sorely missed, and Frank Roberts, and Tom Daly's recitations won very hearty applause. The National Anthem was sung, followed by the joining of hands and the singing of Auld Lang Syne.

This convention, although short, consisting of only four sessions, will probably be remembered as a business one. This was largely owing to the exertions of J. J. York and two or three of the older members. Legislation when effected will greatly strengthen the hands of the association, and benefit the users of steam. The motion for a paid secretary, and the earnest desire that the Executive should be in continual correspondence with the subordinate associations, will no doubt have the effect of increasing the enthusiasm of individual members and holding their interests; and the desire to get the manufacturers to prove the objects of the association by personal attendance at their meetings, is a sufficient answer to the false impression that the C.A.S.E. is a labor organization.



G. B. RISLER.

G. B. Risler was born in Switzerland in 1858, and in his early days had a great liking for machinery, but going out in the world when but 14 years old to find his own living, he had not the desired opportunity to learn his trade as a mechanic. He soon began the firing of steam boilers, and became now and then assistant in the engine room. In 1884 he emigrated to Canada, and was employed for a number of years as sawmill engineer, and in a woolen mill in the same capacity. In 1891 Mr. Risler was engaged by the London, Ont., *Advertiser*, and is yet their engineer. He has been president of the London branch of the C.A.S.E., and has been very active in promoting the interests of the society. Among other evidences of the sincerity of his words is the

fact that Mr. Risler has prepared and had printed at his own expense a series of examination questions, for correct answers to which he has also offered prizes. The date up to which answers to these questions can be sent to compete for the prizes is September 19th. Mr. Risler is one of the most progressive members of a progressive organization.

## NEW SYSTEM OF FILTERING IN USE IN A NUMBER OF GERMAN CITIES.

The State Department at Washington has received an account of a new system of filtering water intended for city use, which should be of interest to the authorities of many municipalities struggling with the problem of purifying river water on a large scale for household and manufacturing purposes.

There is now in operation at the city of Worms, as well as at Kiel, Winterthur, and at several other places in Germany, an improved system of filtering water, known as the Fischer system. Hitherto the method most generally employed has been that of filtering through sand or gravel, and for this purpose a layer thirty to forty inches thick of clean sand, mixed in some cases with charcoal, has been used. The sand being loose and non-adhesive, entails two important economical disadvantages ; First, the area of space required is large in proportion to the amount of water to be treated, and, secondly, all sediment in the water settles upon the sand, which forms the bottom of the filter, and which soon becomes gorged and clogged, so that the filter must be thrown out of use while it can be cleaned by mechanical means.

The new system now in use in the city of Worms is the invention of Director Fischer, for many years past water works engineer at that city, where the use of Rhine water for general purposes presents the same problem that confronts cities like Cincinnati, St. Louis and Brooklyn. The fundamental idea upon which the new system is based is the fact that clean, sharp sand, when mixed in due proportion with finely pulverized glass, forms a porous mass which, by baking under a high pressure, may be hardened in any desired form. The inventor in this case hit upon the plan of molding this porous mass into hollow plates or plaques, about forty inches square and eight inches thick ; that is, with walls three inches in thickness and with about two inches of hollow space in the centre of the plaques. In constructing the filtering plant these plates are set upright in groups of batteries of any number, according to the desired size and capacity of the establishment, and are arranged along the lower portion of one or more tanks of hydraulic masonry, where they can be covered to a depth of three or four feet with the water to be filtered. Being then submerged the water is forced by its own pressure through the porous walls of the plate into the interior hollow space, where it trickles down, and is drawn off through pipes laid at the bottom of the tank to the reservoir, which receives the filtered water. These discharge pipes are rigged with cocks so that each plate and group of plates may be isolated for cleaning purposes, while the adjacent batteries are in operation. For greater economy of space and tubing two tiers of plates are set up, one above the other, whereby both tiers are served by one set of discharge pipes. The water in passing through the three-inch walls of vitrified sand is filtered as perfectly as by traversing three feet of loose sand or gravel in the ordinary sand filtering process. The plates, being set upright and close to each other, increase from eight to ten-fold the filtering surfaces that may be condensed within any given superficial area, thus securing an improved economy of space within frost proof structures.

According to an official report of M. Jansen, of the University of Berlin, who made an exhaustive study of the whole subject at Worms, that city began in 1889 to filter the Rhine water for general purposes by the ordinary sand filtering process. With a filtering surface of 13,000 square feet, 792,000 gallons of water were filtered in twenty-four hours. This supply proved insufficient for the city, and it became necessary to construct an addition to the filtering plant, the cost of which on the sand filtering plan, was estimated at $30,000. Instead of occupying new lands and building additional structures, one of the ten vaults containing the sand filters already in use, was isolated, cleaned out and the space filled with a battery of 500 plates of the Fischer pattern. The whole cost of the change thus made was about $9,600, and the new filters occupying one-ninth as much space as the sand filter, doubled the filtering capacity of the entire installation.

## THE DEEP WATERWAY FROM THE GREAT LAKES TO THE HUDSON RIVER.

The Secretary of War has transmitted to the United States Congress the report of the chief of engineers on the preliminary examination made by Major T. W. Symons, of the Corps of Engineers, U. S. Army, of a ship canal from the great lakes to the Hudson River. The work was done in accordance with a provision in the last River and Harbor bill, directing the examination and calling for estimates of the cost of construction of the most practicable route of such a canal, wholly within the United States, of sufficient capacity to transport the tonnage of the lakes to the sea.

General Wilson, Chief of Engineers, says in the report that it is the opinion of the local officer that the best route for a ship canal is that by way of Niagara River, Lake Ontario, Oswego, Oneida lake and the Mohawk and Hudson rivers, and that this would cost, at rough estimate, $200,000,000. But Major Symons is also of opinion that the Erie canal, when enlarged under the existing plans of the State of New York, would, if the restrictions imposed by the State upon its use be removed, give commercial advantage practically equal to the commercial advantages of a ship canal. Major Symons' says the ship canal is not a project worthy of being undertaken by the general government for the reason that its benefits would not be commensurate with its cost. If this can be further improved by enlargement to a size sufficient for 1,500-ton barges, making the necessary alterations in its alignment so as to continuously give a descending canal all the way from Lake Erie to the Hudson River and canalizing the Mohawk River, Major Symons says, such an improved canal, navigated by barges, would enable freight to be transported between the East and the West at a lower rate than by ship canal navigated by large lake or ocean vessels, and he states that the enlargement of the Erie canal as suggested, with everything adapted to transport the tonnage of the lakes, is a project worthy of being undertaken by the Government, as the benefits derived would be commensurate with the cost, which is estimated approximately at one-fourth that of a ship canal.

Gen. Wilson says that owing to insufficiency of the appropriation only ordinary preliminary examination was made. He says Major Symons, who made the examination, found three possible routes for a ship canal, wholly within the United States. The first extends from Lake Erie via the Upper Niagara, to the vicinity of Tonawanda or La Salle ; thence by canal with locks to the Lower Niagara, at or near Lewiston or some point on Lake Ontario ; thence through Lake Ontario to Oswego ; thence up to Oswego and Oneida River to Oneida Lake, through Oneida Lake; thence across the divide to the Mohawk, and down the Mohawk to the Hudson at Troy. This is designated as the Oswego route, and is the one Major Symons thinks the most practicable.

The second route follows the line of the Erie canal from Lake Erie and the Niagara River to the Hudson.

The third coincides with the first from Lake Erie to Lake Ontario, running thence through Ontario to the St. Lawrence River, and down the St. Lawrence to some point near Ogdensburg ; thence crossing the State of New York to Lake Champlain and up to its head ; thence following in general the route of the Champlain canal to the Hudson at Troy. While Major Symons mentions this as a possible route, he is of the opinion that it is not a practicable one.

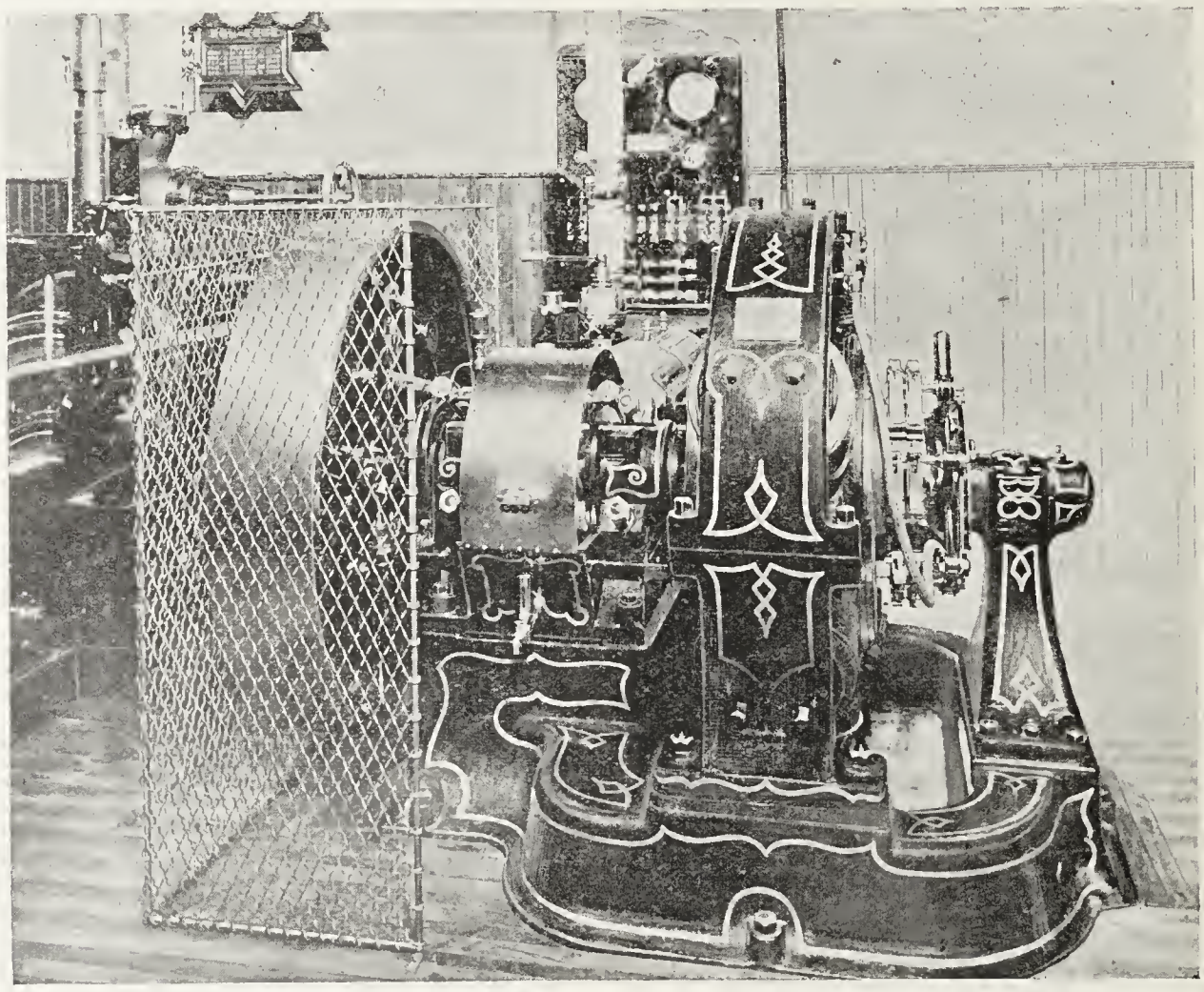
Allusion is also made in the report to still another route, the St. Lawrence-Champlain route, all of which, except a small portion, is in the United States.

The rough estimate, $200,000,000, covers any of the possible routes mentioned. But this estimate, says the report, depends to a very great extent upon the action of the State of New York in regard to its canals, feeders, reservoirs, etc. To maintain such a canal, operate the locks, keep it in repair, etc., would cost at a rough estimate $2,000,000 a year. Such a canal, if constructed, would, the report says, have no military value. Major Symons is of the opinion, says the report, "that the construction of such a canal is not a project worthy of being undertaken by the Government, as the benefits to be derived therefrom would not be properly commensurate with the cost." The cost of the necessary surveys for a ship canal along the Niagara-Oswego route is estimated at $190,000, an entirely independent survey for the enlargement of the Erie canal, $125,000, a combined survey of both, $250,000. In trans-

mitting Major Symons' report the divisions engineer, G. L. Gillespie, says: "The subject of transporting the tonnage of the lakes to the sea is exhaustively treated in this report, and the facts stated and the arguments thereon relative to the methods to be followed are worthy of the closest study by Congress." No definite conclusions and recommendations can be given relative to location and methods of construction, he says, until after the suggested surveys have been made.

## THE O'KEEFE BREWERY COMPANY'S ELECTRICAL PLANT.

The Canadian General Electric Company has recently installed for the O'Keefe Brewery Company (Limited), Toronto, what is probably the most complete isolated electrical plant installed up to the present in any manufacturing establishment in the Dominion. The generator consists of a 25-kilowatt steel frame machine, direct connected to an Ideal engine, running at 305 revolutions per minute. The design and construction of the apparatus are such, it is claimed, as to secure the highest possible efficiency, combined with the greatest durability in service. The frame and pole pieces are cast from a specially selected



soft steel of the highest magnetic permeability. The construction of the armature is such that currents of air circulate constantly through the core, windings and commutator, ventilating them perfectly. The armature windings are straight copper bars, requiring but two joints for each convolution, rendering short circuits and similar troubles practically impossible, and facilitating any repairs which might become necessary on account of mechanical injury. The insulation of all the machines of this type is of the best, combining great mechanical strength and durability with high spark resisting qualities. The increase in temperature up to full load is kept exceedingly low, and the use of carbon brushes insures absolute freedom from sparking under all conditions of load. Since starting up, this unit has shown itself to be entirely satisfactory, requiring practically no attention whatever and being perfectly smooth and noiseless in operation. The switchboard consists of a dark marble panel, upon which are mounted the necessary switches and Weston instruments. A triple pole, double throw switch is used to connect the installation with the three wire mains of the Toronto Incandescent Light Company, at such times as it is not desired to keep the plant in operation. The engine and dynamo has been artistically painted to conform with the finish of the other machinery in the engine room of the O'Keefe Company, and altogether the installation is one which reflects the highest credit upon the manufacturers, as well as being a source of satisfaction to the O'Keefe Company. It might be added, that besides the lighting of the brewery, current is furnished to operate several small motors from which fans, ventilators, etc., are run throughout the buildings. The substitution of electric motors for the small steam engines formerly used for this purpose has been at once a great gain in convenience and an important saving in fuel.

## THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

The annual meeting of the Society for the Promotion of Engineering Education met at the School of Practical Science, August 16th. Henry T. Eddy, of the University of Minnesota, president, occupied the chair.

Among the prominent members present were: John Galbraith, School of Practical Science, Toronto; John M. Ordway, Tulane University; John J. Flater, Purdue University, Lafayette, Ind.: C. Frank Allen, Massachusetts Institute of Technology, Boston; Frank O. Marvin, Joseph P. Jackson, Mansfield Merriman, Harry W. Tyler, Ira O. Baker, D. C. Jackson, John B. Johnson, William Kent, Albert Kingsbury, A. Kingsbury, L. S Randolph, Stillman W. Robinson, Robert H. Thurston, Carl L. Mies, W. G. Raymond, Cady Staley, Robert S. Woodward, Arthur Beardsley, Robert Fletcher, Thomas C. Mendenhall, William H. Schnermann, M. E. Wadsworth.

In his opening address, Dr. Eddy, as president, dealt with engineering education as it is and as it ought to be. He referred to the development of the profession of engineering during the present generation into a place in public estimation as a learned and responsible profession, like law or medicine. Dr. Eddy contended that engineering courses should be completely professional. Two kinds of study interfere with each other, and "culture" studies must disappear from engineering classes. An engineer should obtain his knowledge in those studies preferably before entering upon the study of engineering. Tangible and practical studies were strongly advocated. Organization of the profession and education in the law of contracts were also dwelt upon as very necessary.

After the conclusion of the president's address a paper on "Methods of Teaching," by W. H. P Creighton, was read. "The Calculus for Engineering Students," by F. W. McNair, completed the morning session. At the evening session "The Teaching of Machine Design," by J. J. Flater, opened the session. This was followed by "The Influence of Scientific Research upon the Development of Chemical Technology," by H. Bunte; "Chemical Engineering," by J. M. Ordway; "The Efficiency of Technical as Compared with Literary Training," by T. C. Mendenhall, which called for considerable discussion; "A Course in French and German for Engineers," by A. N. Van Doell, and "At What Point should Students Engage in Scientific Research and How Much Aid should they Receive from the Professor," by C. D. Mark, completed the day's programme.

At the second day's session the morning was devoted largely to the disposal of routine business. The paper on "Mining Vacation Fieldwork," which was promised by Dr. F. W. Denton, professor of mining engineering in the University of Minnesota, and that on the subject, "To what extent should metallurgy be taught in mechanical engineering courses?" promised by Dr. M. E. Cooley, professor of mining engineering in the University of Michigan, were not presented. "At what point should students engage in specific research, and how

much aid should they receive from the professor ? " was the subject of a paper by Prof. C. D. Marx, who said that the inferiority of the instruction in American engineering colleges, except in the laboratories, was due to inferior preparatory training and the lack of teachers who combine theoretical training with wide practical experience. "The average American teacher is overburdened with work sufficiently to prevent giving efficient assistance to the few who take the fifth year and research work. The work of research is itself desirable if undertaken as post-graduate work and under proper conditions. For success in this work, the professor must have the proper training in addition to practical experience, and must be allowed sufficient time for this special work. Present salaries are not calculated to secure many such men, nor are they allowed time for such work. Student's work in research should follow, not precede, research work on the part of the professor." In the afternoon, the members of the society inspected the laboratory in the School of Practical Science and pronounced themselves highly pleased with the completeness of the equipment which the department possesses. Later in the afternoon the members assembled at Prof. Loudon's residence and were guests at the garden party to which they and the members of the Mathematical Society had been invited.

Professor C. M. Woodward read a paper on "Manual Training for Artisans." He pointed out that manual training was neither manual labor nor trade training. Manual training was purely educational, differing from the methods of ordinary workshops or of a trade school. Manual training is an excellent thing for an artisan, as for everyone else. It makes the learning of a trade a very simple and easy matter if one wishes to be a mechanic for a time, but the graduate of a manual training school will probably not become an artisan at all in the ordinary sense. The records show that a great majority of graduates earn more money and achieve greater success in other occupations. If you wish your boy to be a mechanic do not send him to a manual training school ; if you do he may become an architect, an engineer, a lawyer or a physician. Prof. Thos. W. Mather read a paper on "Manual Training in High Schools." He said that two courses of instruction should generally be given in a manual training High School The first should afford preparation for colleges or schools of technology, while in the second it may be assumed the boy's school education must end upon graduation. During the third year a period every day should be given to elementary mechanics experimentally treated. In the fourth year an equal time should be devoted to applied mechanics treated in the same way. This may profitably include heat, steam and the steam engine, the strength of materials and stresses in structures.

Dr. C. S. Murkland read an interesting paper on "Agricultural Colleges, their Function, with Relation to Engineering."

At the close of the meetings the following officers were elected :— President, J. P. Johnston, Washington University ; vice-president, T. C. Mendenhall, Worcester Pyrotechnical Institute, and Harry W. Tyler, Massachusetts Institute of Technology ; secretary, Albert Kingsbury, New Hampshire College of Agriculture ; treasurer, J. A. Flater, Purdue University, Indiana.

## THE AIR SHIP IS HERE.

On the 13th of August, at Vancouver, an object was seen in the sky travelling eastward, which had all the appearance of an air ship, and what was said to be a balloon was reported at three or four different points in Manitoba and the territories. At 12.40 on the morning of the 16th, C. W. Spencer, superintendent of the Eastern Division of the C.P.R., was sitting with Thos. Hay, his assistant, in the observation car of the train which had left Port Arthur for Sudbury, and as they were approaching Gravel River, and sat admiring the clear starlit heavens, they saw, in the words of Coleridge, "a something in the sky." There was a large white light, and at an angle above it on the left a red light and at a like angle on the right a white light. The object appeared to be about half a mile above the earth, and when first seen was at an angle of 30° to 40° above the horizon. It seemed to be moving with the wind about 30 miles an hour, as the train was running at 45 miles an hour, and the object appeared to fall in their wake. When they had watched it about three minutes the train turned inland from the shore of Lake Superior, and before it was hid behind the bluffs it tilted and turned inland, apparently following them up valley. As it turned the red light became blue, and there was disclosed in line with the main headlight a row of four lights terminated by a circle or ellipse of a dozen lights, in the midst of which was the dark body of the air ship. The light had the steady clearness of electric or acetylene light, and Mr. Spencer and Mr. Hay could form no other opinion than that it was an air ship, and if the object seen at Vancouver was the same it must have travelled to this point, 2,100 miles, at the rate of about 700 miles a day. It is quite possible that some inventor has set to work quietly and unostentatiously, and thus put his theories in practice before announcing his discoveries to the world ; and if he has not since come to grief in the wilds north of Lake Superior, we shall soon know that air navigation has been first accomplished on Canadian territory.

## THE LATE F. B. ROBB.

The late F. B. Robb, secretary-treasurer and manager of the Robb Engineering Co., Limited, who was drowned while bathing at Fox Harbor, N.S., July 20th, was born at Amherst, Nova Scotia, on the 8th of November, 1857. His father, the late Alexander Robb, was one of the pioneer manufacturers of Nova Scotia, having established in 1848 the business which has since developed into the Robb Engineering Co. Mr. Robb was educated at the Cumberland County Academy and Dalhousie College, Halifax, afterwards being specially fitted for his work by a short experience in banking and a commercial college course at St. John. In 1876, when nineteen years of age, he, with his brother, D. W. Robb, now president and engineer of the company, took the full management of the extensive business in which he labored up to the time of his death.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain to Canada for July, 1896 and 1897, and the seven months ending July, 1896 and 1897 :

| | Month of July. | | Seven months ending July, | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £4,032 | £5,825 | £36,143 | £37,755 |
| Pig iron | 2,416 | 942 | 12,282 | 3,807 |
| Bar, etc. | 1,068 | 786 | 9,569 | 5,799 |
| Railroad | 40,614 | 17,368 | 88,089 | 37,654 |
| Hoops, sheets, etc. | 8,968 | 8,313 | 25,110 | 31,003 |
| Galvanized sheets | 7,625 | 6,083 | 30,979 | 25,458 |
| Tin plates | 9 681 | 5,987 | 77,235 | 94,942 |
| Cast, wrought, etc., iron | 3,522 | 1,943 | 29,625 | 19,277 |
| Old (for re-manufacture) | 2,496 | 1,080 | 11,422 | 2,577 |
| Steel | 10,778 | 6,099 | 55,185 | 29,537 |
| Lead | 950 | 3,699 | 8,506 | 10,959 |
| Tin, unwrought | 1,796 | 345 | 9 510 | 10,779 |

## FIRES OF THE MONTH.

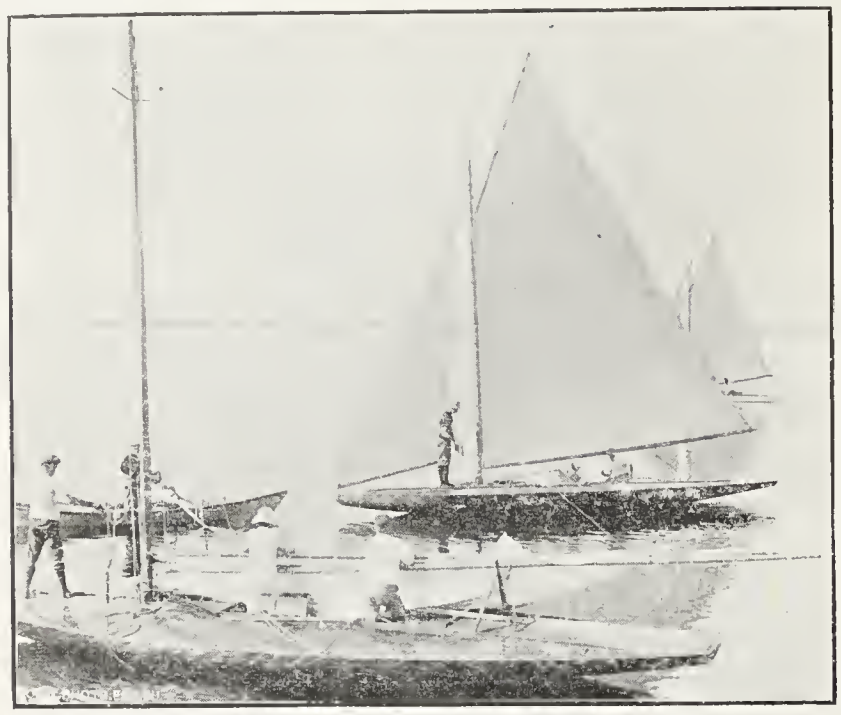
July 29th.—Sash and door factory of H. & F. Swim, Doaktown, N.B. Total loss.——Aug. 4th.—F. Moseley's tannery, St. Hyacinthe, Que. Loss, about $100,000.——Aug. 5th.—The C P.R. round house, at Revelstoke. The company lost a consolidated engine, a rotary snow plough and engine No. 592.——Aug. 15th.—J. T. Harvie's saw and lath mills. Loss, $10,000. — Aug. 19th.—The Hamilton and Toronto Sewer Pipe Co.'s Works, in Hamilton, Ont. Loss, $15,000.—— Aug. 19th.—The Laurie Engine Works, Montreal : roof destroyed and pattern shop damaged.——Aug. 28th.—An explosion in the dust box in the Cobban Mfg. Company's Works, Toronto, caused $600 damage. Fully insured.——Steamer "Acacia" and steam launch "Athena" burned at wharf, Hamilton, Ont. Loss on "Acacia" $6,000 ; on "Athena," $4,000.

CAPTAIN MICHAEL T. FREE, of the Rochester, N.Y., fire department, and son-in-law of Wm. Johnson, Peterboro', Ont., has invented a swivel joint hose nozzle which has received very favorable notice.

THE Wallaceburg, Ont., Glass Company has resumed operations, with a full force of blowers. The company has orders ahead. It is estimated that $100,000 will be paid in wages during the present season.

## THE SEAWANHAKA CHALLENGE CUP.

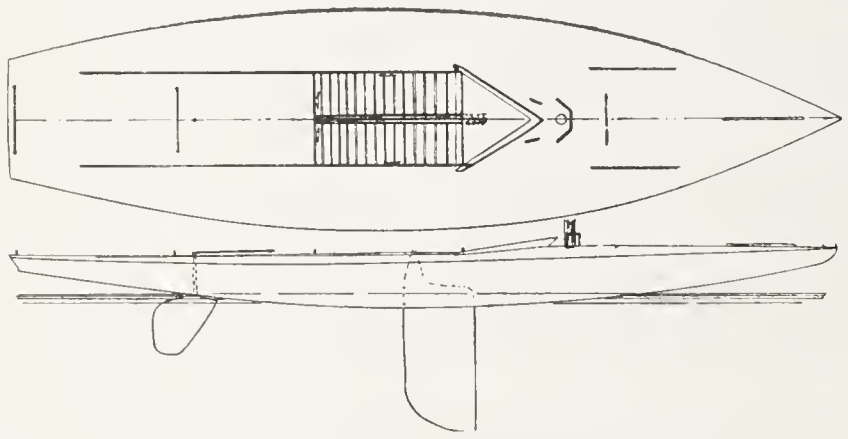
For the second time in succession the Canadian yacht designed by G. H. Duggan, C.E., of the Dominion Bridge Works, has won the Seawanhaka International Challenge Cup. Last year Mr. Duggan



GLENCAIRN II.

gained his victory on salt water at Oyster Bay, this year it was on Lake St. Louis. The race this year was between Mr. Duggan's new yacht "Glencairn II." and the Seawanhaka Corinthian Yacht Club's representative "Momo," three times over a triangular course; total distance 12 miles; the winner to gain three out of five races. The following were the official measurements of the two boats:

| | Glencairn II. | Momo. |
|---|---|---|
| Length over all..... | 32.15 ft. | 29.50 ft. |
| Overhang forward ..... | 8 3 ft. | 6.02 ft. |
| " aft..... | 6.40 ft. | 5.31 ft. |
| L.W.L. ..... | 17.43 ft. | 18.17 ft. |
| Sail area ..... | 489.10 sq. ft. | 456.32 sq. ft. |
| √ Sail area ..... | 22.12 ft. | 21.35 ft. |
| Racing length ..... | 19.77 ft. | 19.76 ft. |



DECK AND SHEAR PLAN OF GLENCAIRN II.

The first race was sailed on the 14th August, in a slight breeze, and was won by "Momo," the "Glencairn" having had a hole stove in her bow at the start. On Monday, 16th, the "Glencairn" won easily in a spanking breeze, and on the two following days repeated her victory, thus securing to Canada the trophy for another

G. H. DUGGAN, C.E., WINNER OF THE SEAWANHAKA CUP.

year. The race was well and fairly sailed, and the stiff gales of the last three days were such as to make the contest a trial of real seamanship. In the final race Mr. Duggan's handling of his yacht, disabled as she was with a torn sail, was admirable.

## RESISTANCE MEASUREMENTS.

In electrical measuring instruments few are more important than the Wheatstone bridge, and this has come to be realized to such an extent that to explain the advantages of this method of measuring resistances, or testing for broken circuits, short circuits and grounds, would be a waste of time and space. The main requirements of such apparatus are, first, that it should be portable, convenient and easy to operate, and durable; second, that it should be accurate under all general conditions; third, it must have a wide range; fourth, it must be low in price.

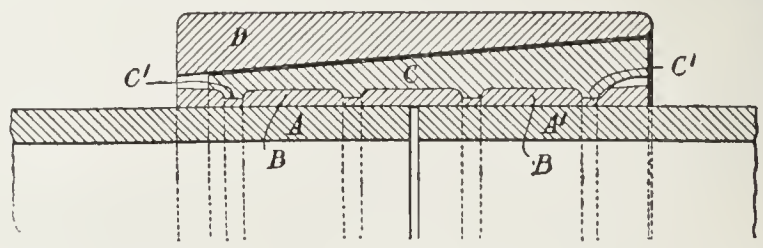
About a year ago, the Whitney Electrical Instrument Company, believing that apparatus combining all of these conditions was not easily obtained, commenced a line of experiments, and in presenting the Whitney Portable Testing Sets, they offer the result of several months study, and an instrument that they claim has been thoroughly tried and every weak feature eliminated. In size it is 8 x 5 x 5½ inches, and it weighs five pounds. They guarantee it accurate to within one-fifth of one per cent., and with its resistances as low as one-tenth of an ohm can be measured. The rheostat arms are formed by the two outside bars, and have a range of from one ohm up. The central bar comprises the two bridge arms, and by plugging or unplugging the ratio coils in these arms, the value of the rheostat coils are divided or multiplied as desired. The galvanometer is designed with especial reference to being extremely sensitive and quick to respond with a small current, and in the measurement of low resistances one cell will be found ample.

These testing sets are made in two styles. With batteries for outside testing and where access to batteries is not convenient, and without batteries for school and laboratory work. The type containing batteries is furnished with six cells so arranged that from one cell up to the full battery can be used. The instrument is also provided with two binding posts, so that battery from an external source can be used if desired. The battery is of the chloride of silver type. The cells will, it is said, last several months in constant service, and may be renewed at a very small expense. The instrument is mounted in handsomely polished mahogany, and all metal parts are substantially finished in lacquer.

The resistance is of special alloy, carefully made and highly insulated. There is, the makers claim, no appreciable temperature error under general conditions. At the present time, these sets are being made in a variety of ranges up to five megohms, and it is the intention of the manufacturers to build them with still greater capacity very soon.

## RING JOINT FOR PIPES.

In the August number of THE CANADIAN ENGINEER we referred to a new system of jointing pipes which was being tested at the works of the Kingston Locomotive and Engine Co. The following description will assist our readers in forming an estimate of the value of this process.




This joint is applicable to steel, iron and other pipes, particularly water and gas mains of large diameter.

It consists of two or more parts, namely:—1. A packing strip; 2, a circumferential tapering wedge, and 3, a sleeve or compression ring. The joint will be best understood by reference to the accompanying figure which shows in sections, taken parallel with the axis of the pipes, the sections being taken through one side only of the pipes. In

all the drawings *A* and *A*1 are the pipes, *B* the packing strip, *C* the taper wedge, and *D* the compression ring.

The packing strip *B* formed of any suitable compressible material, such for example as lead or india rubber, is laid circumferentially round the joint of the pipes. It may be of any width considered desirable, and of rectangular, curvilinear, corrugated or other section, and its edges or ends may overlap or may butt together, either parallel with, or diagonal to the axis of the pipes. It may be in one or more pieces, and though generally a loose piece, it may, if preferred, be fastened either to the taper wedge, which is placed over it, or to one of the pipe ends. Or it may be run into place after the pipes are put together. The taper wedge *C* consists of a band or ring, preferably of steel or other metal, formed in one piece, in which case it is split, or of two or more segments, which may have the ends or edges butting or overlapping, parallel with or diagonal to the axis of the pipes. Packing may be used at the divisions to make them tight if necessary. The wedge may be of any desired length or thickness, and may be plain. Internally it is usually of equal diameter at both ends, but it may be formed with a taper. Externally it is conical or tapering, thus forming a circumferentially tapering compressible wedge or ring, which contracts in diameter under the pressure of the compression ring or sleeve *D* which is forced over it in making the joint. The compression ring *D* consists of a rigid hoop or sleeve, preferably of steel or other metal, of any suitable length or thickness, having its inner surface tapered to correspond with the external taper of the wedge *C*. The inner surface of *D* may be grooved or recessed to reduce the area of its bearing surfaces on the outside of *C*.

The joint is made by forcing the compression ring *D* over the split wedge *C*, thus contracting it, and compressing the packing strip *B* around the ends of the pipes *AA1*. Conversely the joint may be loosened or taken apart by withdrawing the compression ring *D*.

Any suitable means may be employed for forcing the compression ring upon the wedge, such for example, as hammering it on, or using screw, hydraulic, or other power. Clamps or bands may be used placed temporarily round the pipes, and drawn together by screw bolts; two or more hydraulic presses suitably mounted in a suspension cradle may be employed for closing the joint. After the joint has been made the packing strip may, if desired, be caulked into an annular space between the pipes and the ends of the taper wedge.

Referring to the accompanying drawing we see a joint in which the ends of the pipes are butted one against the other. The wedge, *C*, is provided with four projections, *C1*, internally, so as to put pressure on the packing strip, *B*, at those points. This joint is the invention of D. J. Russell Duncan, C.E., who has fully protected it by patents.

Mr. Duncan has also during his visit to Canada had set up at the Kingston Locomotive and Engine Co.'s works a rolling-down machine for producing Williams' patent wedge-joint pipes. By this process steel pipes are made from flat steel sheets, rolled cold by machinery, without the aid of furnaces or heating agencies, and at a cost for labor, it is claimed, less than the cost of producing pipes by other processes. The manufacturer of steel pipes on Williams' patent longitudinal wedge-joint system is dependent upon very simple machinery. Plates, as they are received from the plate mills, are cut to the desired width in a shearing or slitting machine. This machine shears plates perfectly parallel, at the rate of 15 feet per minute. After passing through this machine, they enter the nibbing machine, in which the edges of the plates are bent inwards for about a quarter of an inch. From the nibbing machine the plates pass on to the skelp machine, in which they are bent into semi-cylindrical form. Two plates are employed in the manufacture of each pipe. These plates are bound together by means of two bars of steel, rolled to a channel section. These bars are placed internally in the pipe and the edges of the nibbed plates fit into the recesses in the channel bars. The pipe is then firmly bound by two concavo-convex bars, which run the entire length of the pipe and fit into the channel between the nibbed edges of the plates. The pipe when fitted together ready for rolling down is shipped on a cast-iron mandrel on the rolling-down machine, which exerts great pressure upon the two wedges, and flattens them in such a manner that they are securely locked in the channel bars, and bind the edges of the nibbed plate so effectively that the pipes, when tested, are found to be absolutely water-tight. The wedge bars, rolled down in this manner, may be said to resemble a continuous longitudinal rivet.

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The Vessot Grain Grinder attracted much attention at the Montreal Exposition, and will be entered at the Ottawa and Toronto Exhibitions. The machine is one of the best in the market, having been awarded a gold medal and diploma at the World's Fair, Chicago, 1893. S. Vessot & Co., Joliette, Que., are the manufacturers.

## COMPRESSED AIR.

At pages 343-346, vol. 2, and page 317, vol. 1, of The Canadian Engineer, descriptions are given of the Taylor Hydraulic Air Compressor, now at work at Magog, Que., in operating six engines, showing the printing machinery of the Dominion Cotton Mills Company, using 155 h.p., giving a pressure of 52 lbs. to the square inch. Though very little has yet been done to call attention to the merits of C. H. Taylor's invention, yet its simplicity and the efficiency obtainable from a given fall of water are so great that manufacturers, miners, capitalists, scientists, and every one who may by accident have heard of it, are writing for any available information from all parts of America, Great Britain, and many European countries.

In the meantime, the company has been securing and perfecting its patents in all important countries, and already has sold the rights for British Columbia, Washington, Montana and Idaho, for a large sum, and a company has been formed with head office at Spokane, Wash., to instal the system in those parts. This company is becoming active, and arrangements are about completed to instal a plant at Ainsworth, B.C., to develop 500 horse-power for use in the mines within a radius of five miles.

The plant at Magog has now been tested in all seasons and the system has proved itself faultless, giving the company using it great satisfaction, both in its working and in its economy. No one can see where there is any probability of the plant wearing out or repairs being required during an ordinary life time, unless it be to increase the size of the plant to give more power.

All will accord to steam, electrical and water power their full value, allowing to each a field where they are supreme. All these are now well developed and their usefulness generally understood, yet compressed air, with its possibilities, is as yet a sealed book even to most scientists, though all are accustomed to the usual expression, "Compressed air is the coming power." It has come, and the world is indebted to Mr. Taylor for his ingenious invention, which transforms a water-power into compressed air at a minimum cost and maximum efficiency. Some of the advantages claimed for the system are as follows:—

1. It transforms a water power of any head into compressed air of any desired pressure without the usual intermediate losses.

2. Low heads of water, which would otherwise be useless for the production of power, can be used to advantage by this compressor.

3. The air is compressed at a constant temperature, viz.: that of the water, and is consequently delivered at a temperature generally below that at which it is taken into the compressor. Hence there is no loss of power by contraction in volume.

4. The air during compression is freed by the water of the greater part of its moisture, it being delivered so dry that it is impossible for condensation to take place during either its transmission or subsequent expansion.

Condensation and freezing of moisture in mains, etc., one of the chief obstacles to the use of compressed air, is entirely overcome by this method of hydraulic compression.

5. This compressor will maintain a constant pressure, even under a fluctuating head, without change of efficiency.

6. The compressor is entirely automatic in its action.

7. Owing to the absence of moving machinery the duration of a plant is almost without limit.

8. The absence of moving machinery dispenses with skilled labor, as practically no attendance is required.

9. When the compressed air is not used at the same rate as it is generated, it accumulates and may afterwards give, for a limited time, as much as double the average power developed by the compressor, without change of pressure. This storage of power is effected by displacement of water, and not by an increase of pressure

10. A plant does not require to be covered by a building.

With the question solved as to the compressing of air economically, as it is by the Taylor system, it is only reasonable to expect that progress in rapid strides will now be made by engineers and others to perfect the motor or other apparatus which uses the air, as hitherto all attention was given to the compressor and none to the motor, whilst in the use of steam all attention was given to the perfecting of the engine and not the boiler. The general public can find but little information on compressed air; the most accessible being such as is found in catalogues, in words such as "if you don't buy our compressor you can't use compressed air," in effect condemning unintentionally compressed air. Thus, also, has advancement in its use been retarded.

Again, how little knowledge is abroad regarding the transmission of air power; or, going further, how few engineers or scientists know anything of importance regarding its transmittable qualities? As it can only be transmitted through pipes, there is of course some decrease of pressure from friction, and hence some loss of power at the delivery

end, but far from as much as most imagine. Catalogues have done injury here to the cause of compressed air, though unwittingly, by printing tables showing the loss of pressure due to the friction of air in pipes, the intention being to show the size of the most suitable pipe for given cases of transmission. And while telling about loss of pressure, they fail to tell that that loss does not necessarily mean to the same extent a loss of power. Take a distance of, say, 10 miles, and the fact is said to be that there is but very slight loss of power if the pipes be of proper size If gauge pressure be, say, 80 lbs., or 95 absolute, on entering the pipe, and 70 lbs., or 85 absolute, at the other end, there would be a loss of a little above 10 per cent. in absolute pressure; but there would be an increase of volume of 11 per cent. to make up for the loss of pressure; thus the loss of available power would be less than 3 per cent. With higher pressure, still more favorable results could be shown. Such a power produced as economically as by the Taylor system, must surely be a "coming power."

# Mining Matters.

QUICKSILVER is said to have been discovered just outside of Dartmouth, N.S., recently.

THE Elginfield Oil and Gas Co. struck a fine gas well near Wallacetown, Ont., recently.

THE Dardanelles Mine, Nelson, B.C., will soon have a steam plant air compressor in place, it is said.

THE smelting works in Hamilton, Ont., are receiving ore from the Coe Hill iron mine in Hastings county, Ont.

THE Ruth mines, Sandon, B.C., will put in a concentrator, and the Slocan Star Company has surveyed a site at Cody for one to treat the ore from their Noonday property.

THE long-standing trouble between the town of Kingsville, Ont. and the Natural Gas Company that has been supplying the town, has been settled by the town buying out the plant of the company for $27,000.

GOLD has been discovered on the farm of James McLean, about two and one-half miles above McDonald's Corners, Lanark County, Ont. Experts are at work to ascertain whether it can be worked to advantage.

THE Pictou Charcoal Iron Company has given a lease with option to purchase their blast furnace and plant at Bridgeville, N.S., to the Mineral Products Company, which intends operating the deposit of bog manganese near Hillsboro.

THE Canadian Gold Fields Co. has ordered from the Ingersoll-Sergeant Drill Co. a seven-drill compressor, 80-horse power steel machine drills, Ledgerwood hoisting engine and all necessary adjuncts, to be delivered by the Drill Company, ready for operation, in 45 days from August 7th.

A CONTRACT has been let for the machinery for a 100-ton concentrator and a double tramway 8,500 feet long for the Montezuma Mining Company, Kaslo Creek, B.C. The cost of the tramway and concentrator complete will be about $45,000. The mill will be erected under the supervision of T. L. Mitchell.

A VERY important discovery of gold-bearing rock is reported on what is known as the Diamond property, in the tenth concession of Madoc, Ont. D. E. K. Stewart has found a vein, four feet wide, of mispickel, with quartz showing free gold. The mispickel assayed several hundred dollars per ton. The vein has been stripped for several hundred feet, and a shaft has been sunk to a depth of 10 feet.

A MEETING of the British Columbia Association of Mining Engineers was held in New Denver, B.C., recently. Among others present were: H. West, A.R.S.M., A. J. Colquhoun, M. E. F. Monckton, F.G.S, A. Dick, Captain Morrish and M. A. Bucke. It was decided to affiliate with the Canadian Mining Federation, also to make arrangements for a grand rally and banquet in Vancouver next January. The association aims to be representative of the mining engineers and mine owners of British Columbia, and has upwards of 80 members, all of whom are men of standing in the profession.

SOME changes in the British Columbia mining regulations are looked for at the next session of the legislature, as the outcome of Prof. Carlyle's recent tour of the mines. The present Act is most liberal, in that it admits of the recording of locations before performing any development work whatever; there is a disposition on the part of claim owners to shirk the annual assessment falling due within the year following the location of claims by a system of re-locating. The effect of this is that large areas are staked off and no work is performed beyond the driving of the stakes. In one district one man was holding sixty claims. The regulations will, therefore, be made more stringent.

THE Trail, B.C., smelter produced the first gold brick, Aug. 11th.

VERY rich discoveries of gold are reported from Indian Head, near Sherbrooke, N.S.

THE Dominion Coal Company shipped about 150,000 tons of coal up the St. Lawrence in July.

A SAW MILL and stamp mill will, it is said, be built at once at Bell City, Seine River district, Ont.

N. H. STEVENS, Dr. Holmes and others have organized a company to supply Chatham, Ont., with natural gas from Kingsville.

A. W. CARSCALLEN has ordered from the Wm. Hamilton Mfg. Co., Peterboro, Ont, for the Belmont gold mine, a ten-stamp mill.

AT Deloro, Ont., the Canadian Gold Fields Company has increased its force to two hundred men, and they are working day and night.

DR. W. L. GOODWIN and F. J. Cope have recently held prospectors' classes in connection with the School of Mining and Agriculture in Madoc and Bancroft, Ont.

P. HEIMINCK & Co. propose to establish a smelter at Edmonton N.W.T., on condition of receiving a bonus of $10,000 and certain exemptions.

GOLD is reported to be found in paying quantities in Ottawa county, on the farm of Louis Dozios, on the north shore of the Ottawa River, about twelve miles above Aylmer, Que.

THE North-Western Mining and Development Company is said to have struck a silver mine in the township of Barrie, Frontenac county, Ont. After going down twenty-five feet the vein was seven feet wide. The ore assays from $56 to $300 per ton.

JAMES KING, Quebec; W. Yuile, Montreal; J. de Labroquerie Tache, St. Hyacinthe; J. R. Tache, Quebec, and L. Gendreau, St. George's, are to be incorporated as the Central Quebec Gold Fields Company; capital stock, $6,000; head office, Quebec.

A COMMITTEE, consisting of Oliver Durant, J. B. McArthur, and J. F. McCrae, appointed by a mass meeting of the citizens of Rossland B.C., has prepared a memorial to lay before the Dominion Government, protesting against the imposition of an export duty on British Columbia ores.

THE British Admiralty has ordered sixty tons of coal from the newly-discovered veins on the west coast of Newfoundland, to be used by the warship "Buzzard" as a test. If the quality of coal is satisfactory St. John's will, it is said, be created a dockyard and naval station.

FEODOR BOAS, managing director of the Danville Asbestos Company, and J. N. Greenshields, Q.C., of Montreal, are at present opening up a new mine about three miles from Danville, Que., on the Richmond road. Some years ago a vein of galena was discovered and the samples submitted to an analyst showed 63 per cent. copper and $13 silver per ton.

PROF. A. P. COLEMAN, Ontario Government geologist, recently returned from a tour through the mineral regions of Western Ontario, and reports some interesting facts. The area in the Wahnapitae region in which gold mines of importance have been found, is comparatively small. "I think," he says, "it will be much more extensive as soon as prospecting goes on. At present some of the townships are closed to prospectors pending an enquiry into the character and extent of the timber resources which exist there. Several new finds have been made at Mosher Bay, one of the upper arms of Lake Manitou One of a very promising character belonged to Gasse & Leullier, two Frenchmen. There was a very large body of quartz which would average seven feet in width, and the owners had followed it along the face of a hill for half a mile, and had opened it for perhaps 25 or 35 feet. I saw a number of specimens while there that were quite rich. In the Saw Bill Region a number of finds of very rich quartz, containing free gold, were made before I left there," Dr. Coleman explained. Those were to the north of Lynx Head Falls, and prospectors were to be encountered everywhere. It is probable that a considerable amount of gold will be found in that district, judging from appearances.

TEXADA ISLAND is a veritable wonderland. By the steamer "Maude" the owners of the Nutcracker claim on Texada Island received a number of specimens from their claim which in richness and apparent permanency eclipse anything yet received from the far-famed Texada. The specimens were taken from the bottom of the shaft being sunk by McCloskie & McDonald. The depth is about 22 feet, and the ledge opened out four feet wide. The gold is of a very bright color, resembling Australian gold. The specimens also give evidence of being rich in silver. Experts pronounce it the most valuable of the many developments of Texada Island, insomuch as the gold is in solid rock and not in the surface crevices, the same as the Lorindale and other claims. They have only struck the foot wall, and, although the ledge has been opened four feet, it has not yet reached the hanging wall. The owners are Mrs. Edwin Gough and Robert Evans of the Nanaimo

Hotel, and J. W. Stirtan, superintendent of the Nanaimo waterworks. The Van Anda "Copper Queen" shaft is taking out some fine rich variegated copper ore, which should from all appearances run high in value. The Raven mine has now got a well-defined vein of payable ore and will soon be making regular shipments. Operations at the Kirk Lake gold mines are in full swing. The new hoist plant and pump are expected to arrive within the next few days. The directors are negotiating now for a twenty-stamp mill which is expected to be in operation not later than October 1st. The Kirk Lake Company have over 1,200 tons of ore on the dump ready for milling which from tests made from shipments to San Francisco and Tacoma shows an average value from $22 50 to $64 per ton. The Surprise mine is erecting hoist plant, and will sink to the 250 foot level. The Silver Tip mine shipped 100 sacks of ore on the steamer "Comox" and the Victoria-Texada mine shipped 100 sacks of ore on the steamer "Maude" to Victoria. A notable fact is that so far all veins have improved most remarkably at 100 feet depth, and the general outlook is that the island will ere long be a busy hive of workmen, as soon as a little more development work is done.—*Nanaimo Free Press.*

Jas. Breen, manager of the Le Roi smelter, recently gave the following reasons for the selection of Northport as the site for the new plant: "One of the principal reasons is that in the operation of a smelter of 300 tons capacity it will require approximately 40 tons of limestone daily to flux the excess of silica contained in the Le Roi ore. This limestone now costs the B. C. S. & R. Company, whose smelter is located on the Columbia River at Trail, $3.50 per ton. The Le Roi Company at Northport can deliver a superior quality of limestone to any found in Kootenay in their works for 25 cents a ton, saving approximately $50,000 a year in this item alone. We can lay down coke in Northport for $2.50 per ton less than in Trail, and in our smelting operations we will use about 45 tons of coke per day, making a saving in this item of $45,000 per year. We will also save $1.50 per ton on coal, of which we will use about 20 tons per day, making a saving of $10,000 a year. The cost of our plant will be reduced 5 per cent. by reason of cheaper building material and freight rates, without considering the innumerable articles entering into the construction of a smelter which have to pay duty, notwithstanding that the machinery comes into Canada duty free. On renewals and repairs there will be a monthly expense of $2,500, on which there will be a saving of $2.50 per ton in freight and 30 per cent. in duties as against any point on this side of the line. The saving in this item alone will approximate $15,000 a year. We will save at least $1.50 per ton on outgoing freight. On a basis of 20 tons per day this will amount to $15,000 per year. Taking these items and others which I have not mentioned, for instance the saving of $1 per cord on wood, this represents roughly a saving of $150,000 per year, or $1.50 per ton of ore smelted. It is patent to everyone that this is just so much saved to the producers of ore in the Rossland district, and were an export duty placed on ore this saving would not be effected. It should also be borne in mind that besides establishing competition in smelting, the erection of the Northport plant secures a freight rate on ore of 75 cents per ton, instead of $2, as heretofore charged."

In an interview with a representative of the Toronto *World*, J. A. Caldwell, proprietor of the famous Sultana mine, gives the following details about the mine. The main shaft is now down 360 feet, with 1,000 feet of drifting distributed over five levels. The vein being lenticular in form, has narrowed and at times almost pinched out; but the lead is never lost. Up to the present time the mine has been operated by a plant consisting of a few light drills and a ten-stamp mill, which latter, by the way, has come in for a lot of criticism by certain experts, for the stated reason that it did not save as much of the gold as it should, a considerable percentage passing off in the tailings; but Mr. Caldwell said that he is getting from 75 to 80 per cent. of the gold in his ore in the batteries and on the plates, and 10 per cent. more in the concentrates, or from 85 to 90 per cent. altogether, which is an extremely high and satisfactory average. Machinery of high capacity is now being installed; the capacity of the mill is to be increased five times. At present 30 head of stamps are being put in place, but room and power are being supplied for 50 stamps. The new boilers, shafting, etc., are equal to the calls of a 50-head mill. The mill is to be very complete, with the latest and most approved Gates crusher, batteries, vanners, etc., and will have a daily capacity of 80 tons of ore. A new chlorination plant will handle the concentrates. In the new mill, which is being put up on the side hill beside the old one, gravitation will be taken advantage of in conveying ore from the shaft. In order to keep this big mill going skips and a 75-horse power hoisting engine are being installed, together with pump and a compound duplex air compressor, capable of furnishing power to 10 or 12 drills. Only eight, however, will be run this fall. There is a large quantity of ore in the five levels ready for stoping, so that, with the extra drills, there will be no difficulty in getting out the necessary 80 tons per day. From the new shaft house, now in course of erection, the rock will be run on a level tramway to the crusher. The mine has a water power system and an electric light plant of its own. Most of this machinery is made in Canada, being furnished by the Jenckes Machine Company of Sherbrooke, Que., and the Canadian Rand Drill Company.

# Electric Flashes.

Acton, Ont., will probably have electric light in the near future.

An electric light plant will be placed in the Jackson & Cochrane foundry, Galt, Ont.

The Lanark county electric railway bonus by-law, which was voted on recently, in Perth, Ont., was defeated by a majority of over fifty.

The Connecticut Telephone and Electric Company, of Chicago, U.S., have been making enquiries in reference to a telephone franchise in Toronto recently.

I. J. Gould, owner of the present electric light service in Uxbridge, Ont, will probably extend his plant by the addition of incandescent lighting to that now in service.

Carleton Place, Ont., is in favor of the Lanark County Electric Railway. A public meeting to discuss the scheme was held recently, and it was unanimous in support of it.

J. A. McLeay, M.D., of Watford, Ont., has purchased from the Royal Electric Company a 500 light alternator and the necessary transformers, and is installing an incandescent plant in the town of Watford.

G. A. Clare, of Clare Bros. & Co., stove and furnace manufacturers of Preston, Ont., says that much of the business activity of that town is due to the freight facilities provided by the Galt, Hespeler and Preston Electric Railway.

A peculiar accident resulted in the burning out of the motor used to open and close the swing bridge at the beach, Hamilton, Ont., not long ago. The watch chain of the man in charge dropped in such a way as to short circuit the motor with the result mentioned.

The Exeter, Ont., Electric Light and Power Company, recently organized to take over the lighting business in Exeter, formerly operated on a small scale by Captain Howard, has placed an order with the Canadian General Electric Company for a 1,000-light, single phase alternator, of the standard iron-clad armature compound-wound type.

La Compagnie Electrique, of Chicoutimi, Que., has increased the lighting capacity of its plant by the addition of another 40 K. W. "S. K. C." Generator, which it has purchased from the Royal Electric Co. This addition has been made necessary owing to the growth of their power transmission work.

Pamphine Boivin, of the town of Baie St. Paul, Que., has received a franchise from the corporation of that town for electric lighting, and the Royal Electric Company is now installing for him an electric lighting plant consisting of a 500 light "S.K.C." dynamo, with the necessary transformers and material.

The Kootenay Electric Company, of Kaslo, B.C., who have a large water power near the town, and purpose using the same for power and lighting, have placed their order with the Royal Electric Co. for a 75 K. W. "S.K.C." generator, and the necessary transformers and motors. The water will be carried in by a 42-inch stave pipe flume about 1,300 feet long, which will run to the power house.

Some years ago the Dominion Government claimed duty on all the rails brought into Canada for street traffic purposes, and compelled payment of the same after they had got a decision in their favor in the Canadian Supreme Court. The Toronto Railway Company carried the case to the Privy Council, and got a judgment in their favor, and the money paid in by them was refunded by the Government. Recently the Toronto Railway Company made a motion before the Privy Council to have the interest allowed on the duties paid by the company, and judgment was given in favor of the motion, so that the Government will be compelled to pay a further sum of $10,000 or $11,000 to the railway company.

The new Electric Locomotive recently shipped from the works of the Canadian General Electric Co. to the Hull Electric Co., is the largest machine of the kind so far constructed in Canada. The motive power will be furnished by a four-motor equipment of G. E. 51 motors, having at normal current input a capacity of 80 horse-power each. The trucks are of the McGuire "L" pattern, with steel rim wheels. The body, which differs in operation and detail from the first locomotive supplied to the Hull Electric Company, was built for the Canadian General Electric Company by the Crossen Car Company of Cobourg, Ont.

THE Bell Telephone Co. is putting in an up-to-date switchboard in the Ingersoll office.

THE new power-house for the Sherbrooke Street Railway Co. is being built by Loomis & Sons, Sherbrooke, Que.

THE Fenelon Falls Lumber Company has purchased a 250 light incandescent plant from the Canadian General Electric Company.

THE Yarmouth, N S., Street Railway Company has purchased a 45 kilowatt generator from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 150-light incandescent plant for the estate of Ross Bros., Buckingham, Que.

I. MATHESON & Co., Limited, New Glasgow, N.S., have purchased an incandescent lighting generator from the Canadian General Electric Company.

THE Montreal Street Railway Company has placed an order for fifty additional G. E. 1,000 motors with the Canadian General Electric Company.

THE Canadian General Electric Company is installing an incandescent lighting machine for the Toronto Paper Company at the Cornwall, Ont., mills.

THE Canadian General Electric Company is constructing a 75 kilowatt steel frame, direct connected, direct current generator, for McGill University, Montreal.

THE British Columbia Mills Trading Co., Vancouver, B.C., is lighting its mills by electricity, the plant being furnished by the Royal Electric Co , Montreal.

DORAIS & DOBBIN is the style of a new firm of electrical contractors, 4 Beaver Hall Hill, Montreal, which makes a specialty of equipping electric lights and bells.

THE Canadian Pacific Railway Co. has recently largely increased the staff in its car shops at Perth, Ont., and is working overtime. The Royal Electric Co. is installing a plant in the shops.

CHAMPOUX & BROS , Disraeli, Que., are installing a 650 light alternating current dynamo, which they purchased from the Royal Electric Co. They are lighting the town and their mills.

THE Doherty Organ Company, Clinton, Ont., requiring an increased dynamo capacity, has placed an order with the Canadian General Electric Company for a 200 light incandescent machine of the Edison type.

R. SMITH & Co., Sherbrooke, Que., have recently installed a 100-light plant in the Montague Paper Company's new steam saw-mill, at Lake Megantic, Que., and are also building a 200 light electric plant, alternating current, for Dr. Edgar, North Hatley, Que.

THE Canadian General Electric Company has received an order for a 2,000-light, single phase alternator for Revelstoke, B.C. This machine, which will be of the standard iron-clad revolving armature type, compounded to secure automatic regulation, will be used to supply incandescent lighting in Revelstoke and vicinity.

THE CANADIAN ENGINEER had the honor to receive an invitation to attend the 19th annual Rhode Island clam dinner tendered to the electrical fraternity by Eugene F. Phillips, president of the American Electrical Works, Provideuce, R.I., at the Pomham Club, August 21st. It is unnecessary to say we regretted our inability to attend.

THE Canadian General Electric Company is installing a 75 kilowatt monocyclic generator for Kilmer, Cowan & Co., of Southampton, Ont. This machine, which will be operated from a water power, conveniently located, will supply current for incandescent lighting and power for the two neighboring towns of Southampton and Port Elgin, Ontario.

ON August 20th the Kingston Street Railway was handed over from 2 to 10 o'clock p.m. to the nurses of the Kingston General Hospital, who acted as conductors and collected the fares in aid of the Hospital. Quite a handsome sum was realized, and kindly comments were made on the philanthropy of B. W. Folger, the proprietor of the road, which took this form.

THIS is a time of peace, says a Maritime Province exchange, but the defences of Halifax harbor are to be strengthened. A powerful electric searchlight will be placed in the fort at York redoubt, at the entrance to the harbor, and a new battery for quick-firing guns built at Point Pleasant, making four batteries within gunsbot of each other, though hidden in the woods of the public park.

THE corporation of Magog, Que., has awarded the Canadian General Electric Company the contract for a 1,000-light single phase alternator and other apparatus for their new incandescent lighting plant. The street lighting will be done by 64-50 c.p. incandescent lamps, which are expected to furnish a much more satisfactory street lighting service than their equivalent of arc lamps.

THE patent rights for Canada of a new storage battery which is now in use, after ten years test, by the Electrical Power Storage Co., London, are advertised for sale in this issue of THE CANADIAN ENGINEER.

THE Aylmer Electric Light and Mfg. Company, Aylmer, Ont., is installing an extensive incandescent lighting system. It has awarded the contract for the apparatus required for the plant to the Canadian General Electric Company. The generator will consist of a 60 kilowatt, 1,000-light standard single phase alternator of the revolving iron-clad armature type, compounded to secure automatic regulation.

# Personal.

PIERRE POITRAS, contractor, Chicoutimi, Que., died not long ago.

JOHN R. ALLAN, O.L.S., is to be the engineer for O'Neil & Ferguson on their contract in the Crow's Nest Pass Railway.

ROBERT BARROW, son of City Engineer Barrow, Hamilton, Ont., has gone to the Klondike with a Government exploration party.

J. G. SIBBALD, who has represented the Carnegie firm, of Pittsburg, for some time in Montreal, died recently in New London, Conn.

R. E. L. BROWN, W. H. Young and J. R. Stephens have opened an office in Victoria, B.C., and are doing business as mining engineers.

WHILE bathing in the St. Lawrence, at the Montreal plumbers' picnic, held August 14th, A. Lebel, machinist, was accidentally drowned.

H. SMITH, engineer at Wortman & Ward's foundry, London, Ont., was recently seriously burned while throwing refuse paint into the furnace.

THE death was announced by cable recently of Mrs. A. Galt, mother of John Galt, C.E., of Toronto, which took place at Kilmarnock, Scotland.

R. CARR HARRIS, C.E., formerly professor of engineering in the Royal Military College, Kingston, Ont., has started for the Klondike, taking his two sons with him.

PATRICK G. ALEXANDER represented the *Engineer*, London, England, at the meeting of the British Association for the Advancement of Science, in Toronto, last month.

CAPTAIN P. G. TWINING, R.E., instructor of engineering at the Royal Military College, Kingston, Ont., was married to Miss Louise Daly, of Napanee, Ont., last month.

AS a result of changes in the engineering department of the Grand Trunk, William Crawford, Hamilton, Ont., will be master of buildings and bridges, with headquarters at London.

JOSEPH NICHOLSON, foreman of the tin department, has been appointed superintendent of the tin, stamping, re-tinning, galvanizing, japanning, enamelling and machine shops at the McClary Manufacturing Co.'s works, London, Ont.

W. W. LA CHANCE, formerly of the firm of Gregg & La Chance, architects and engineers, Cleveland, Ohio, has returned to Hamilton, Ont., his native city, to resume his profession as architect, after spending ten years in the United States.

T. R. DEACON, C.E., has formed a partnership with J. E. Switzer, O.L.S., C.E., late assistant city engineer for Ottawa, Ont., and the new firm of Deacon & Switzer will carry on the business of engineering and surveying at Rat Portage, Ont.

C. F. HANINGTON, C.E., Shediac, N.B., has been appointed assistant engineer of the Crow's Nest Pass Railway. Mr. Hanington has had a large experience in railroad engineering, and was a member of the staff on the original survey of the C.P.R.

W. T. JENNINGS, C.E., late city engineer of Toronto, who was formerly with the C.P.R., has been engaged by the Dominion Government to go out immediately with a party and furnish a report on the best means of getting into the Klondike country by railway over an all-Canadian route. At the same time he will take a look at others, and in fact at all available routes, so as to supply information upon which the executive may rely.

FREDERICK PRESTON RUBIDGE, for thirty years architect of the Public Works Department, Ottawa, and one of the most eminent members of his profession in the Dominion, died at his residence recently, in Montreal, in the ninety-second year of his age. The deceased was superannuated in 1872, previous to which he was actively employed on the parliamentary and departmental buildings, and superintended the construction, midway up Parliament Hill, of the picturesque path known as the "Lovers' Walk." The first few years after retiring from the civil service Mr. Rubidge spent at Ottawa, removing then to Hamilton, and some fourteen years ago to Montreal.

GRANVILL C. CUNNINGHAM was presented with an address by 800 employees of the Montreal Street Railway Co. previous to his leaving for Birmingham, Eng.

A. C. STONEGRAVE has been appointed general agent of the freight and passenger departments of the Central Vermont Ry. in Canada, a promotion upon which he has received many congratulations. His offices will be in the Board of Trade Building, Montreal, P.Q.

ROBERT MITCHELL, president of the Robert Mitchell Co., Limited, brass founders, died at the age of 76 in his home, in Montreal, Sept. 1st. He was a native of Scotland, being born at Prestonpans. He was in business in Montreal from 1851, and has always been one of the most prominent business men of the city, though his modesty prevented his taking the part in public affairs that those who knew him felt he was qualified to fill.

PETER MCMICHAEL, for many years the popular assistant manager of the Toronto branch of the James Robertson Company, Limited, has been promoted to be manager of the St. John, N.B., branch of the firm. On the eve of his departure a few of the many business firms, who, by contact, had recognized his sterling qualities, presented him with a costly diamond ring and illuminated address. The following firms were represented at the presentation: Booth Copper Co., Limited, per G. H. Booth; Goderich Organ Co., Alex. Saunders; Miln-Bingham Printing Co., James Miln; Montreal Rolling Mills Co., John Irving; James Morrison Brass Mfg. Co., James Morrison; John Ritchie Plumbing Co., Limited, A. N. Richardson; Toronto Foundry Co., H. W. Anthes; Toronto Radiator Co., Adam Taylor; Toronto Hardware Co., J. H. Paterson; Toronto Steel Clad Bath Co., A. G. Booth; Toronto Standard Manufacturing Co., J. J. Torrance; Gurney Foundry Co., Limited, W. N. Garrick.

MAJOR HENRY FULLERTON PERLEY, M. Inst. C.E., who died at Bisley, Eng., July 17th, from bronchitis, was a resident of Ottawa. He was born in St. John, N.B., in 1831. He entered the public service of New Brunswick in the year 1848, continuing until the summer of 1852 on exploratory surveys for a proposed system of railways. In 1852 he was engaged by Pets, Betts & Brassey on surveys in the province of New Brunswick and Nova Scotia, and employed by them during 1854-55-56 on the construction of the Grand Trunk Railway between Montreal and Brockville. In August, 1856, he again entered the service of New Brunswick as resident engineer on the construction of the E. & N A. Railway between St. John and Shediac, remaining until the completion of the line in December, 1860. Between 1861 and 1863 he was engaged in private practice. In May, 1863, he entered the service of the Government of Nova Scotia, continuing as provincial engineer until August, 1865; then resigning to fill the position of agent for Keth, Waring Bros. and Lucas, contractors for the construction of the Metropolitan Extension (underground) Railway, London, England. At the completion of this engagement, in 1870, he returned to New Brunswick and took charge of the works in connection with the improvement of the freighting facilities of the Government Railway in that province, and the construction of the deep water terminus and extension line at St. John. In May, 1872, he was appointed engineer in charge of harbors, etc., in the Maritime provinces for the Department of Public Works, which position he held until the close of 1879, when he was appointed chief engineer. This position he held up to 1891.

# Railway Matters.

IT is said that 27 bridges will be required on the Crow's Nest Pass Railway between Medicine Hat and Lethbridge.

THE Ottawa and New York Railway is not to be compelled to put a draw span into its St. Lawrence bridge at Cornwall, in spite of the objections of the shipping interest to any obstructions in the navigation.

WM. RUSSELL, C.E., is now engaged in locating the line of the Pembroke Southern Railway, which will connect Pembroke with the Ottawa, Arnprior and Parry Sound Railway. The distance to be built is twenty miles.

THE Quebec Central Railway Company is commencing to relay a considerable portion of the main line between Sherbrooke and Quebec with new seventy pound steel rails. The Carnegie Steel Company are supplying the rails.

THE employees of the Pacific Division of the C.P.R. recently presented H. Abbott, late general superintendent, with a massive silver punch bowl, and a pair of candlesticks and a purse of money. The presentation was suitably acknowledged by Mr. Abbott.

WE are requested to announce that the next annual convention of the Association of Railway Superintendents of Bridges and Buildings will be held at the Brown Palace Hotel, Denver, Colorado, on Tuesday, Oct. 19th. The secretary is S. F. Patterson, Moberly, Mo., from whom the programme can be obtained.

SOME of the contracts let for the construction of the New York and Ottawa Railway are: Grading, Peppard & Balch, Minneapolis, Minn.; rails, Johnston & Co., Johnstown, Pa.; masonry for bridges, Soovsmith & Co., New York; iron work on bridge, Phœnix Construction Company. The contract for the bridge requires that it shall be ready for construction trains on November 15, and for general traffic on January 1, 1898.

THE C. P. Ry. have taken out a permit to build a $14,000 engine shed at the foot of Simcoe st., Toronto, and shops for light repair will be built. The making up of trains will be done along the water front, so that many engineers, firemen, baggagemen and others will be moved from Parkdale, where such work has been hitherto done.

THE Canada Atlantic are building a line, about six miles in length, from Lacolle, in the county of St. Johns, Que., to a place called Alburgh Springs, in the State of Vermont. This includes a bridge across the Richelieu, the latter being built by day work. The contractor for the road is Mr. Fauquier, who built a good portion of the Parry Sound extension of the Canada Atlantic. Mr. Mitchell, of Kingston, is the sub-contractor, and the new line will in all probability be completed by October next.

ABOUT 100 miles of the Crow's Nest Pass road is already under contract, and track-laying began at Lethbridge on the 29th July, and was commenced at McLeod, 40 miles westward, early in August. The second fifty miles have been divided into sections of from five to ten miles long, and awarded to Messrs. McArthur, Buchanan, Strevel Keith and Bowels, all of Winnipeg; McGillivery, of Vancouver, and Hugh Mann, of Rossland. It is more than probable that the first hundred miles will be completed before the end of the year and another section well under way.

GENERAL MANAGER CAMPBELL, of the Dominion Atlantic Railway of Nova Scotia, has made the following changes in the staff: The resignation of the resident manager, K. Sutherland, went into effect at the end of July, and P. Griffin is appointed to the position. Mr. Sutherland was in addition to superintendent the road's engineer. Edward M. Stewart, C.E., who came out from Scotland two months ago with Mr. Campbell, is appointed chief engineer.

THE Montfort Colonization Railway Company are pushing the extension of their line to Arundel, Que. The railway has already been built from St. Sauveur Junction, on the Canadian Pacific, to a distance of 21 miles, and now 12 miles additional are being built, bringing the road to Arundel, and making a total of 33 miles. Unfortunately, when the Montfort road was started, the directors decided to make the gauge three feet, which necessitates a great deal of difficulty in the transhipment of freight at St. Sauveur Junction. A movement is on foot to have the line changed to the standard gauge.

J. M. SHANLY, engineer of the Atlantic and Lake Superior Railway Co., reports that the work of ballasting the road from Metapedia to Caplin, 80 miles, is progressing and two trains a day are running. The contract for grading from Caplin to Paspebiac, 20 miles, has been awarded to Perrault & Gervais, who will finish their work this fall. There will be two bridges, one over the Big Bonaventure River, 300 feet long, and the other over the Little Bonaventure, 60 feet, both of which will be constructed of stone, with an iron superstructure. The proposed extension to Gaspe Basin will not be near as heavy work as was to be anticipated

# Marine News.

THE Inland Navigation Company, capital $13,000, of Charlottetown, P.E.I., is applying for incorporation.

RODOLPH E. LEMIEUX, M.P., and Robert Lindsay, of Gaspe, have arranged with the Department of Commerce for placing a weekly service for freight and passengers on the St. Lawrence, between Quebec and Gaspe. There will be only one steamer to commence with.

AT the meeting of the shareholders of the Canada Shipping Company held in Montreal recently, the offer of Peterson, Tate & Co. to purchase all the steamships of the old Beaver line, to take over the office and the whole of the business of what is known as the Canada Shipping Company, was accepted.

THE Department of Public Works has just finished at Sorel a large dredge, called "The Laurier." It will be escorted by a new steel tug, to which Mr. Tarte has given the name of "St. Johns and Iberville," the division which he represents. The Minister is negotiating for a plot of land at Sorel on which to erect additional new workshops.

THE C.P.R. will add to its fleet on the Columbia an express boat for carrying passengers, mail and express. The keel of the new boat was recently laid at Nakusp. It is thought this boat will be the fastest in any of the inland waters of the North West. It is expected to make the time from Trail to Arrowhead in 24 hours, equal to 19 miles an hour. She will be christened "The Flyer."

To meet the opposition of the line from Alexandria Bay to Montreal, the R. & O. Nav. Co. have placed three extra steamers a week on that route, the extra boats reaching Montreal an hour before the regular boat. The company contemplate building two new palace steamers to run between Toronto and Prescott, and to be built with turbine propellers of the type referred to in a late issue. Such boats would be capable of making 35 to 40 miles per hour, and would do the trip from Toronto to Kingston in from four to five hours if no stops were made at lake ports. No decision has yet been come to on this matter, but meanwhile the regular boats will be altered and improved, adapting them better for tourist travel.

Recent English papers contain accounts of the launching of two magnificent ships for the Elder-Dempster Company of Liverpool and Montreal. One was launched at Wallsend-on-Tyne, and christened the "Monarch." She and her sister ship the "Milwaukee" are the largest freight steamers yet built in England. Her dead weight cargo capacity is 11,500 tons, while her measurement cargo is over 18,000 tons, besides 700 tons of bunker capacity. Her length is 483 feet, beam 56 feet, depth 42 feet 3 inches to the shelter deck. She has 12 steam winches for handling cargo, is lighted by electricity, and the cattle stalls, etc., are of the latest type. The other boat, the "Montrose," was launched at Middlesborough. She has a dead-weight capacity of over 8,000 tons, is 460 feet long, 52 feet beam and 30.7 feet deep. She is fitted up with cold storage apparatus for dairy produce, etc.

## LITERARY NOTES.

The 41st annual report on the sewage and water supply of St. John, N.B., has been compiled by Wm. Murdoch, C.E., engineer of the department. The daily average water supply for St. John is 4,903,100 gallons, being 138.2 per head of population, or deducting that used by manufacturers, railway and shipping, etc., 124 gals. per head of east side population. During the year 79 new services were laid at an average cost of $24.64 each. The total pipeage of the city is 95.15 miles. There are 174 water meters in use. During the year there were 4,400 feet of sewers built, at a cost of $13,852. One of these, which was a difficult work, will be referred to again in this journal.

We have heard so much of old London lately, that a sketch of our Canadian London will be specially interesting by way of contrast, and therefore the new history of London, Ont., compiled by Archie Brem[illegible]ner, and published by the London Printing and Lithographing Company, is both timely and valuable. This work contains 136 pages 9 x 12 inches, and is illustrated by over 300 half tone engravings, including a map of Western Ontario. The illustrations alone would almost portray the history of the city, but the writer has given a most graphic and entertaining narrative of the evolution of a modern Canadian city from its log cabin beginnings, in 1826, down to the Jubilee celebration of this very year, and embracing almost every phase of its civic life and all its institutions. The book is free from advertisements, and is creditable alike to the author and the printers and publishers. Sample pages and prospectus will be sent to any one interested.

We have to thank Chevalier Chs. Baillairge, librarian of the Geographical Society of Quebec, for a copy of the transactions of that society from 1893-97, which make a volume of 340 pages in all. This society is doing a most important work in showing the greatness and value of our unknown northern regions, and deserves the encouragement they are now seeking from the Government. Among the contributors, besides M. Baillairge, are Dr. Robt. Bell, A. P. Low, John Bignell, H. O'Sullivan, and others well known in connection with exploratory work, and several engravings and maps accompany the papers. The work throws a good deal of light on the regions about Hudson and James' Bays, and will be specially valuable now that those regions must soon be opened up by means of railways. We hope to refer to the work at greater length in another issue.

The annual report of the several departments of the city government of Halifax, N.S., has reached us. It is a neat pamphlet of over 300 pages, and gives details of all the departments of the city government. The engineering departments contain many indications of the skillful management of F. W. W. Doane, C.E., the city engineer.

A very attractive pamphlet describing the city of Hartford, Conn., and its principal industries has been published, describing, among other concerns, the Skinner Chuck Co. The sketch shows that the business of this company has developed very rapidly since its establishment in 1887, a development evidently due to the superiority of the firm's products. The company have several patents on their chucks, which are turned out on the most modern machinery by skilled workmen. The Skinner Chuck Co. have an extensive trade all over the continent, including Canada, and will be glad to furnish information about their specialties to those interested.

We have received a pamphlet from the International Correspondence Schools, of Scranton, Pa., which contains 1,000 letters written by friends of the school to testify their appreciation of the advantages it offers.

We notice from the calendar of the Kingston, Ont., School of Mining that the entrance examinations for the session 1897-98 begin Sept. 16th.

## Industrial Notes.

The school trustees of Oxford, N.S., have decided to erect new school buildings to cost $7,950.

The town engineer of St. Stephens, N.B., has been authorized to invite tenders for sewers, for which the sum of $5,000 has been appropriated.

The E. B. Eddy Co., of Hull, will put in a separate system of waterworks, having 40 hydrants, with a pumping force of 5,000 gallons per minute.

The Joliette Lumber Company's mills at St. Gabriel de Brandon, is handling pulp wood at the rate of 50 cords barked per day, besides cutting 50 to 60 thousand feet of lumber daily.

A large number of elevator owners in Manitoba and the North-West generally are looking into the possibilities of gasoline engines, and several have already been ordered, it is said.

Drummond, McCall & Co., Montreal, who have the contract for St. Lambert's waterworks system, will employ from 100 to 150 men until the completion of the contract in November.

A. E. Whitehouse has commenced business at 684 Craig street, Montreal, as a general machinist and engineer, giving special attention to gas engines, printing machinery, bicycle work and model making.

The St. Lawrence Foundry Co., Toronto, is now building a full line of fire hydrants, gate and check valves, and some waterworks appliances not hitherto made in Canada. A further reference to the firm's products will be made in our next issue.

A. Cushing & Co. offer to erect a pulp mill of a capacity of twenty tons per day, near their big saw mill at the St. John Falls, if the city of St. John will supply the water free. The mill would cost $150,000, and will pay out $60,000 a year in wages.

The third annual meeting of the shareholders of the Taylor Hydraulic Air Compressing Company, Ltd., was held at the offices of the company, 183 St. James street, Montreal, last month, and the following were elected directors: Samuel Carsley, president; Joseph B. Fair, vice-president; George Durnford, William H. Campbell and R. L. Murchison.

McOuat & McRae founders and machinists, Lachute, are getting very busy on orders for their specialties. This firm make a patent frost dog and patent timber gauge for lumber manufacturers, both of which are coming into general use as the best thing of the kind yet invented. They also make a "stuff" pump for paper mills, which is now used by all the leading paper and pulp mills of Canada. These and stationary fire pumps and friction clutches are among the special lines made by this progressive firm.

Hamelin & Ayers, of Lachute, Que., are building a large dam across the North River below their present woolen mills. Forty men are employed on the dam, which is 360 feet wide, 28 feet high from the river bottom, with a base of 84 feet. It is of the "beaver" type and gives a head of 23 feet at the dam, or by carrying the water across a peninsula formed by a bend in the river the head can be increased to 33 feet. The work will be finished this month, and the owners will sell or lease the power for manufacturing purposes.

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# The Canadian Engineer

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. III.—(*Continued.*)

ARTICLE 10.—EASEMENT ON TRANSITION CURVES.

In article 6, under "Curve Resistances," is given formula (8), which indicates the amount that the outer rail on a curve should be elevated above the inner one, but, as the two rails on the adjoining tangents are of the same height at any given point, the question arises as to the best manner of effecting this change of conditions so as to lessen any shock to passengers or rolling stock, or indeed to entirely abolish it. Practice has determined that, where there is distance enough to permit, the curve super-elevation ought not to be lowered more than $\frac{1}{2}$ inch per rail length (30 feet), or (*e.g.*) on a 10° curve of $\frac{1}{2}$ inch super-elevation per degree, this would require a distance of 300 feet. The most common practice in America has been to bring the full elevation to the ends of the curve, and then lower it on the tangents. This, evidently, will act so that as a train approaches a curve the play of the wheels ($\frac{1}{2}$ inch to 1 inch) will all be at the outside, *i.e.*, the wheels will press against the inner rail, and then, at the instant the curve is reached, there will be a lurch to the outside in assuming the natural position, in passing round a curve, of the front wheel of each truck against the outer rail.

Some have tried to remedy this by lowering the elevation partially on the curve, and partially on the tangents, which merely divides one shock into two smaller ones. The true remedy lies in not making an abrupt change in horizontal alignment from a curve to a tangent or *vice versa;* but in so arranging the track at each end of a curve, that commencing with a curve of infinite radius, this radius is gradually decreased, *i.e.*, the curve is sharpened, and at the same time, the elevation of the outer rail is increased, keeping this elevation at each point just sufficient for the curvature until a junction is made with the main circular curve, with a curvature equal to it, and with a full elevation, and having kept an equipoise between curve and elevation at each instant, all lurches and shocks will be avoided. That this is the only true and rational solution, is proven by the fact that practical trackmen, unguided and even hindered, often, by engineers' rigid centre stakes, but recognizing the evil and its remedy, have introduced crude easement curves wherever they could do so, and improved the situation as much as possible; but as the tangent and main circular curve were both fixed in position by construction, all that could be done was to flatten the ends of the curve at the expense of the adjoining portions, which were thus made sharper than the main curve itself, and formed more or less of elbows in the track, often 2° or 3° sharper than the main curve.

Now this can be avoided by moving the curve inward bodily, or by changing the position or direction of the tangents, or by sharpening the whole curve slightly, any of which will permit of the introduction of proper easement curves at the two ends of the circular curve. Many methods have been advocated for putting in these easements, the endeavor being to simplify the process, in point of time and mental effort, and still preserve the essentials. Some of these are: (*a*) A succession of short pieces of curves of decreasing radii. (*b*) A modification of (*a*) in the form of a spiral. (*c*) A modified quadratic parabola (Holbrook spiral). (*d*) A modified cubic parabola. As any one of these can, when once understood, be easily laid out in the field, it is only necessary to decide on the most adaptable and suitable one for all cases to be met with, and study its theory and actually use it, after which its seeming difficult nature and laborious methods of application, so long dreaded by many railway engineers, will be found quite simple, and capable of rapid manipulation.

Almost all engineers are agreed that transitions are intrinsically necessary, and on European and the best American tracks their use has become established; the chief objections to their general adoption here have been the deeply rooted ideas that they were difficult to apply and too refined for ordinary use, but as speeds are being increased and competition is keener, they are beginning to be used by all roads of any importance because the consequent easier riding caters to the travelling public and also because the wear and tear on the rolling stock, and the difficulty of keeping the ends of curves in proper line, are thereby much decreased.

(*a*) This first class of transitions does not require any

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

demonstration. Some engineers put 100 feet or 200 feet of a curve of larger radius at each end of the main curve, and trust to the trackman for the rest, others introduce a series of short arcs of decreasing radii, say 30 feet of 1° curve, 30 feet of 2° curve, etc., leading up to the main curve at the rate of 30 feet per degree; this necessitates placing the transit every 30 feet, is a tedious and clumsy method, and the result is that the trackmen fuse one portion into another until it is, to all intents and purposes, the same as a spiral. It does not admit of ordinary calculation or manipulation unless modified as in the next paragraph.

(*b*) In "The Railway Spiral," by Searles, is given a complete analysis of the transit work necessary to lay down a succesion of short circular arcs, beginning at zero, and having equal lengths of arcs of equal increments of sharpness, *e.g.*, 20 feet of 1° curve, 20 feet of 2° curve, etc., up to any required sharpness. Tables of deflections are worked out, so that any point of change of curvature can be used as a transit site, and any point of change can be established from any other point of change by transit deflections. Methods of conversion are also given, so that from one foundation series other deflection tables may be determined suitable for spirals of more or less rapid sharpening. The subject is well discussed and thoroughly worked out for all probable conditions, but as it does not present that same flexibility and simplicity of use which the cubic parabola possesses, its continued use is doubtful. It has served its day, and, where used, furnished the trackmen with a succession of hubs, really the ends of arcs of increasing sharpness, but practically points on a spiral very suitable for an easement curve.

(*c*) The Holbrook spiral (quadratic parabola). The idea involved in this easement curve is that the *vertical* acceleration of the train, as it passes around it, should be uniform. If we let $t$ represent horizontal distances (with train moving at a uniform speed) in the general formula $s = \frac{1}{2}$ ft.$^2$, then, in order to keep $f$ (acceleration) constant, the distance, $s$, (*i.e.*) the amount which the train rises above the normal tangent level, must vary as the (distance)$^2$, and as the elevation should always bear a constant ratio to the degree of curve at each point, therefore the degree of curve on this required spiral must vary as the square of the distance from the zero of such a curve, (*i.e.*) the radius of curvature, at each instant, must vary *inversely* as the distance from the zero of the curve

A curve of such a nature has the equation $y = (f)x^4$ to represent it, and is a curve very flat at the beginning, but increasing very rapidly in curvature. This easement curve sacrifices the correct horizontal alignment, as will be seen in the next paragraph, for a supposed refinement in the vertical one; it is quite difficult to apply except in most ordinary cases, as the formulæ used involve expansions of sine and cosine, does not prevent any advantage over the cubic parabola, and is not so adaptable or easy to manipulate in the case of any problems having special conditions (*d*).

### The Cubic Parabola.

This curve as adapted to transitions to railway circular curves has been studied pretty thoroughly. Howard, Armstrong, and others have written pamphlets on it; the transactions C.S.C.E. for 1891, 1892 and 1893 have several papers and discussions on it, and its probable originator, the late A. M. Wellington, determined very simple equations for it which were published in the *Engineering News*, January and February, 1890.

It is this last demonstration that will be now given to which will be added necessary developments. The curve required for a suitable transition is one which starting with an infinite radius or $D$ (degree of curve) = $O$. at the $B\ T\ C$ ($A$ Figs. 13 and 14) has a degree of curve at each point in direct proportion to its distance from the $B\ T\ C$ until it joins and becomes tangent to the main curve at $C$, and is, at that point, of the same degree of curvature as the main curve.

The cubic parabola $y = (f)\,x^3$ approximates to these conditions.

Let $A\ M\ C$ (Fig. 13) be the cubic parabola, $A\ C^1$ tangent to it at $A$, and $I\ C$ the radius of the $D$ degree curve with which it connects at $C$, having there a common tangent $I^1\ C$.

Figure 13.

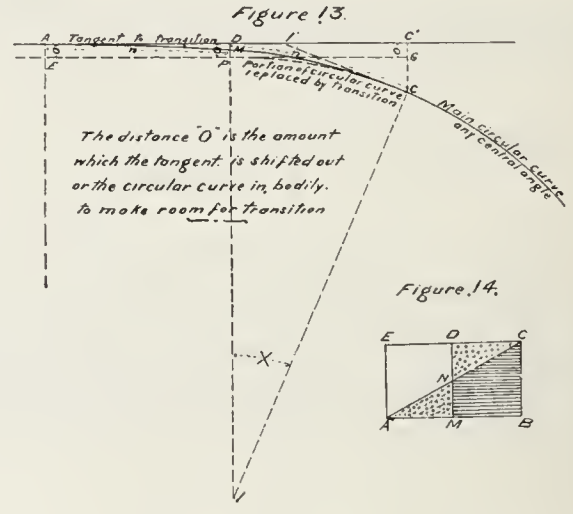

A Tangent & transition
D
I
C'
Portion of circular curve replaced by transition
Main circular curve and continuation
The distance "O" is the amount which the tangent is shifted out or the circular curve in bodily, to make room for transition
X

Figure 14.




Figure 15.

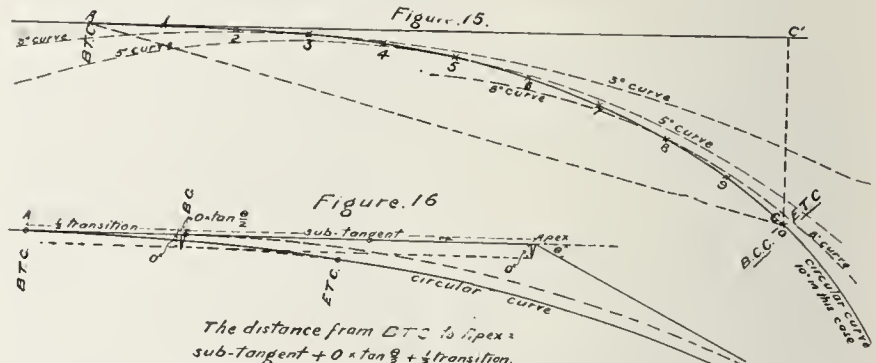



Figure 16




Figure 17.

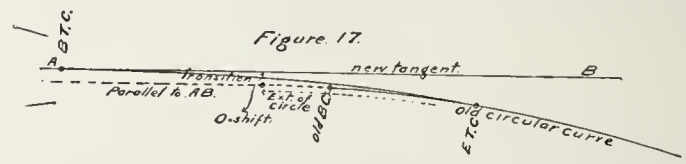
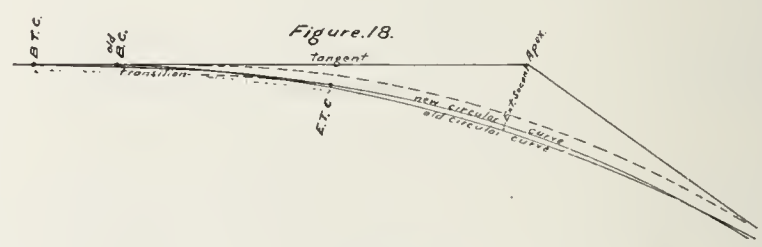



Figure 18.




Let $X$ be the central angle of the circular arc $P\ C$, which is changed into the transition curve $A\ M\ C$.

Let $E\ P\ G$ be tangent to $P\ C$ at $P$ and therefore parallel to $A\ C^1$, and make $C\ C^1$ perpendicular to $A\ C^1$.

Also in Fig. 14, let vertical heights represent degrees of curvature at any point and horizontal distances, measurements along the cubic parabola.

Then the rectangle D B will represent graphically the circular arc $P\ C$, and the triangle $A\ B\ C$ represent graphically the cubic parabola $A\ M\ C$, and from this diagram and Fig. 13 we may readily conclude:

(1) Because the total angles of the arc $P\ C$ and the transition $A\ M\ C$ are equal, therefore the area of the triangle $A\ B\ C$ must equal the area of the rectangle $D\ B$, and therefore a transition curve is always twice as long as that portion of the circular curve which it replaces.

(2) Because the triangles $A\ M\ N$ and $C\ D\ N$ are equal and similar, therefore the angular deflections or offsets from the tangent to every point in $A\ M$ (Fig. 13), and

from the circular curve outward to every corresponding point in the equal distance $C\ M$, are equal in magnitude and distribution, and $\therefore\ D\ M$ is equal to $M\ P$ and half of $D\ P$ (Fig. 13). Hence the offset or shift $D\ P\ (= O)$, and the transition curve $A\ M\ C$ bisect each other at $M$.

(3) The offsets from a tangent to a circular curve vary as the square of the distance from the tangent point (nearly), or to formulate it $O$ varies as $n^2\ D$.

Where $O$ = offset from tangent,

$n$ = distance of the offset from the tangent point,

$D$ = degree of curve,

but by our definition of a transition curve the degree of curve at any instant also varies as $n$. Therefore in a transition curve of this nature $O$ varies as $n^2 \times n = n^3$.....(12), and also by paragraph (2). If we have a given offset from tangent to circular curve at $D = D\ P\ (= O)$, then the offset to the transition curve at a distance $m$ from $A$ is equal to $\left(\frac{m}{n}\right)^3 \frac{O}{2}$ where $n = \frac{1}{2}$ length of transition $= A\ M = M\ C$. And, in the same way, measuring back from $C$ along the curve toward $P$ at any distance, $m$ the offset outward from the circular curve to the transition curve $= \left(\frac{m}{n}\right)^3 \frac{O}{2}$ ..... (13)

The equation to the cubic parabola can now be established in terms of the offset $O$ and $\frac{1}{2}$ length $n$. let $y = C\ x^3$, but when $y = \frac{O}{2}, x = n$, therefore $C = \frac{O}{2} \times \frac{1}{n_3}$

and $\therefore y = \frac{O}{2n^3}\ x^3$ ..... (14)

(4) because by equation (12) offsets to a transition curve vary as cube of distance from origin, therefore in Fig. (13) $C\ C^1 = 8 \times D\ M = 4\ O$.....(15)

Now, for very small angles, $G\ C = P\ C \times \text{Sin}\ \frac{X}{2}$ (nearly), and $P\ C = 2 \times I\ C \times \text{Sin}\ \frac{X}{2}$ (nearly), therefore by substitution we get

$G\ C = 3\ O = 2\ I\ C \times \text{Sin}^2\ \frac{X}{2}$ (nearly), but $I\ C = \frac{5730}{D}$ ($D$ = degree of curve), and $\therefore\ O = \frac{3820}{D} \times \text{Sin}^2\ \frac{X}{2}$, and

$\text{Sin}\ \frac{X}{2} = \sqrt{\frac{O \times D}{3820}} = .01618\ \sqrt{O \times D}$ .....(16)

from which we can get $X$, having $O$ and $D$; or otherwise, since $n = \frac{X}{D}$ (evidently), and for small angles $\text{Sin}\frac{X}{2} = .0087\ X$ (in degrees).

$\therefore$ substituting in (16), we get

$X = \frac{.01618}{.0087}\ \sqrt{O \times D} = 1.86\ \sqrt{O \times D}$ ..... .(17)

and $n = \frac{1}{2}$ length of transition $= 1.86\ \frac{\sqrt{O \times D}}{D} = 1.86 \sqrt{\frac{O}{D}}$ .....(18)

This can also be put in the approximate form,

$O = \frac{n^2}{6R}$ .....(19)

Where $R$ = radius of the curve.

Equations (12) to (19) give such relations between $X, n$, $O$ and $D$ as will enable any length of transition curve to be put in for any degree of curve.

(*e.g.*) Let $D$ = 10° curve, and $O$ = 10 feet.

Substituting in (18) we get, $n$ = 186 feet, or the transition is $2n$ = 372 feet, which is somewhat longer than is needed.

(*e.g.*) Let $X$ = 15°, and $D$ = 10° curve.

Then, $O = \frac{15 \times 15}{(1.86)^2 \times 10} = 6.5$ feet, and $n = 100 \times 1.86 \sqrt{\frac{6.5}{10}} =$ 150 feet, which latter could have been determined directly.

Also $\frac{O}{2} = \frac{6.5}{2} = 3.25$ feet, and any other offset will vary as cube of distance from $A$; that at the quarter points being, for instance, $(\frac{1}{2})^3 \times 3.25 = .41$ feet.

A most usual length of transition is 30 feet per degree of curve, which permits of the super elevation being lowered at $\frac{1}{2}$ inch per 30 feet = 1 rail length, which is a most usual amount.

Now, although these equations enable us to put in transitions by offsets, if we have for instance, the tangents already in place, and can move the main curves inward bodily so as to permit the requisite "shift" $O$, which is very useful if, on construction, the rigid curves and tangents are found already in place, and offsetting is the quickest method to use—still, we also wish to be able to put in transitions as a regular part of location, and not as an afterthought, and to do so it is necessary to determine methods of locating such curves by transit deflections from the beginning, end, or intermediate points.

Any small angular deflection from a meridian to any point varies as $\frac{\text{offset}}{\text{distance}}$, or in other words the natural tangent of any small angle is its circular measure.

Now referring to equation (12) and Fig. (13) any offset from the tangent $A\ C$ to the transition curve varies as the cube of the distance from $A$.

$\therefore$ angular deflections to the transition curve from tangent $A\ C$, using $A$ as origin, vary as $\frac{\text{offset}}{\text{distance}} = \frac{(\text{distance})^3}{\text{distance}} = (\text{distance})^2$ ..... (20)

Also in Fig. (13) $\frac{G\ C}{A\ C} = \frac{1}{2} \frac{G\ C}{P\ C} = \frac{1}{2} \times \frac{X}{2} = \frac{3 \times O}{2 \times n}$ (evidently)

$\therefore\ X = \frac{6 \times O}{n}$ but the angle $C^1AC = \frac{C^1\ C}{C\ A} = \frac{4 \times O}{2 \times n} = \frac{2 \times O}{n}$

$\therefore$ the angle $C^1\ A\ C = \frac{1}{3} \times \frac{6 \times O}{n} = \frac{1}{3}\ X$ ..... (21)

Equations (20) and (21) enable us to determine any deflections to the transition curve from the point $A$; (*e.g.*) let a 10° curve have a transition curve 300 feet long then $X = \frac{n}{D} = \frac{300}{2} \times \frac{1}{10} = 15°$.

$\therefore$ by (21) the angle $C^1\ A\ C = 5° = 300' =$ deflection from tangent at $A$ to the end of the transition, and by equation (20) the deflections to each 30′ intermediate point are:

1st 30 ft. point $\left(\frac{30}{300}\right)^2 \times 300' = 03'$

2nd " $\left(\frac{60}{300}\right)^2 \times 300' = 12'$

3rd " $\left(\frac{90}{300}\right)^2 \times 300' = 27'$

4th " $\left(\frac{120}{300}\right)^2 \times 300' = 48'$

etc., etc., etc., etc.

This series of deflections from the origin $A$, continued as far as necessary, may be called *a foundation series*, and is the basis of all deflections forward or backward from any point. We must now, in order to fix on intermediate deflections, with the transit also at some intermediate point, look on a transition curve, thus: (See Fig. 15). Suppose it to be stopped at 1, then it is a transition curve to a 1°

curve; if stopped at 2, it is a transition curve to a 2° curve, etc.; therefore if the transition *does* continue past the points 1, 2, 3, etc., we may consider it to be composed of two parts: 1st, a 1°, or 2°, or 3°, etc., curve, according to circumstances. 2nd. Plus the *foundation series* of 3′, 12′, 27′, 48′, etc., beginning at the point considered, and continuing forward to any desired extent, and the transition curve deflections are the sum of these two. Also, in the same way, the transition curve deflections looking backward, with transit at any point, are those of a certain degree of curve corresponding to this point, minus the same *foundation series;* (e.g.) suppose the transit to be at the point 3, with the vernier at zero, and line of sight tangent to the curve, then the vernier readings to each intermediate point would be—

$$(A) -\left(\frac{90}{100}\times\frac{180'}{2}-27'\right)= -0^\circ\ 54'.$$

$$(1) -\left(\frac{60}{100}\times\frac{180'}{2}-12'\right)= -0^\circ\ 42'.$$

$$(2) -\left(\frac{30}{100}\times\frac{180'}{2}-3'\right)= -0^\circ\ 24'.$$

(3) $0^\circ\ 0' = 0^\circ\ 0$ position of transit.

$$(4) +\left(\frac{30'}{100}\times\frac{180'}{2}+3'\right)= +0^\circ\ 30'.$$

$$(5) +\left(\frac{60}{100}\times\frac{180'}{2}+12'\right)= +1^\circ\ 06'.$$

$$(6) +\left(\frac{90}{100}\times\frac{180'}{2}+27'\right)= +1^\circ\ 48'.$$

$$(7) +\left(\frac{120}{100}\times\frac{180'}{2}+48'\right)= +2^\circ\ 36',\ \text{etc.}$$

In this way a table can be prepared giving deflections to be made to any point (every 30 feet), with transit located at any point. These tables are conveniently made out by Mr. Armstrong, for 30-foot chords = 1 rail length; but different foundation series and different tables may be made out, or special calculations made by equations (12) to (20) for a transition curve of any rapidity of sharpening, but of the same nature and handled in the same way. This is often necessary where there is not room between the *BC* of one curve and *EC* of the previous one to permit of the introduction of transitions which sharpen so slowly as 30 feet per degree.

In street railway work, for instance, transitions sharpening from 0° to 20°, or even 40°, etc., are needed, and must not occupy more than 20 or 30 feet in length. Special corrections must be applied in such a case, and even for steam railways Mr. Armstrong has worked out corrections in lengths to apply to the very approximate equations here given, but as the correction is zero until an 8° curve is reached, and only 1 foot in 300 for a 10° curve, it is hardly worth taking account of here. Any one desiring extreme accuracy for curves from 8° upward, are referred to J. S. Armstrong's pamphlet.

The three problems most frequently met with in practice are briefly as follows:

1. (See Fig. 16.) To keep tangents fixed and to move the circular curve inward, retaining the same degree of curvature. In this case, take an arbitrary offset or length of transition, and determine the other unknowns by foregoing equations. The distance from the apex of tangents to the *B T C* consists of three parts:

(*a*) Sub-tangent of circular curve $= R \times \tan\frac{\theta}{2}$ ($R$ = radius).

(*b*) Correction of shift $= O \times \tan\frac{\theta}{2}$. (See Fig. 16).

(*c*) ½ length of transition $= n$.

The amount in (*b*) is usually very small, unless $\theta$ is large.

2. (See Fig. 17.) To keep the circular curve fixed, and move out the tangents either in direction or position, or both: If the tangents are moved outward and kept parallel to their original positions, proceed as in (1), except that the correction of shift (*b*) does not exist. If the tangents are not moved outward parallel to their original positions, but pivoted about some distant point, then calculate the angle pivoted, and continue the circular curve through an equal central angle. So that a tangent to the curve at the new *B C* or *E C* would be parallel to the pivoted tangent; then measure the amount of shift *O*, and by the ordinary equations calculate the unknowns; the amount of shift *O* could be calculated without any field work. No correction of shift is here necessary; this second case is most usually met with in revising location, and is very convenient often in the final slight movement of tangents or curves, by avoiding the running over again of the whole circular curves, often situated on a rough hillside or heavy bush, and yet enabling a tangent to be moved on to better ground.

3. (See Fig. 18). To sharpen a curve and introduce transitions, so that the track will not be altered in length; this problem is the one met with in re-running old track centres where transition curves have not been previously used.

The method of solution is to assume an external secant slightly less than the original one, by an amount = expected shift, *O*, + an arbitrary amount of five inches to ten inches, depending on the sharpness and total central angle of the circular curve; then calculate the transitions and complete position of a curve of assumed external secant and given total central angle, and, either by plotting or calculations, determine whether this new curve will cross the original one about at the ¼ points and give the same length of track, thereby minimizing the movement of the track. If in error, a second trial will give usually satisfactory results. This method will often be found to give transitions, which, unless the central angle is large, will occupy the whole central angle, leaving no circular curve at the centre. As this is not desirable, it is preferable in a case of this kind to use shorter and sharper transitions, so as to retain a considerable portion of circular curve at the centre.

While these are the three usual problems to solve, others may arise such as introducing a transition at a point of compound curvature which needs special solutions. For further details, the reader is referred to the literature already mentioned, and the engineer, young or old, who has not used transitions in the field, is advised to become familiar with some one of the forms given, and actually put it into practice, when its seeming tediousness and difficult nature will disappear.

He should recognize that, as he would be quite ready to spend a few hours extra now and then, during railway construction or maintenance, on trivial matters such as affect the general appearance of the road only, and are not really important, he should be far more willing to give much additional labor and attention to such a question as this, when the returns will be increased comfort to travellers, decreased wear on rolling stock, and greater ease in retaining good alignment at the ends of curves. Whenever transitions have been used, their beneficial effects have at once been recognized, and once established trackmen maintain them easily and instinctively. Some of the oldest and most conservative of the American roads are now engaged in introducing them on their permanent tracks.

## STEAM TURBINES.

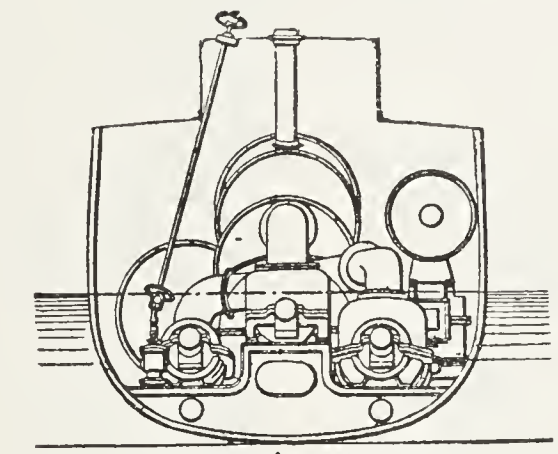
In the July issue of THE CANADIAN ENGINEER there appeared a description of the "Turbinia," the English torpedo-boat destroyer, whose great speed has attracted world-wide attention to the novel motor (the invention of the Hon. C. H. Parsons) which moves her propellers. We are now able to give drawings of the "Turbinia" and a fuller description of the turbine engines.

The Parsons' turbine consists essentially of a cylindrical case. Attached to the inner surface of the case are a number of rows of inwardly-projecting blades, which extend radially towards the axis of the engine. The function of these is to guide the steam. Through the axis of the engine there passes a shaft which is directly coupled to the screw-shaft. On the axial shaft is mounted a light drum, the external diameter of which is some inches less than the internal diameter of the case. When, therefore, the drum is placed inside the case and co-axial with it, there is left an annular space. This space is occupied by the blades, projecting inwards from the case before referred to, and by other rows of outwardly projecting blades attached to the outer surface of the light drum. The blades on the outer cylinder are called "guide blades," and the similar blades are known as "moving blades." When steam at pressure is admitted to the annular space it first comes in contact with a ring of the fixed guide blades, which are so formed as to direct the flow of steam on to the adjacent ring of moving blades at an angle to the surface of the latter, such as will cause the moving blades to rotate round the axis of the engine. As they are firmly attached to the drum, and as the latter is fixed to the shaft, motive power for a screw propeller or a dynamo is thus obtained. There are, of course, numerous alternate rings of guide blades and moving blades, there being perhaps eighty rows of both in an ordinary Parsons turbine. When the steam has been directed on one course by a ring of moving blades, it requires to have its line of motion altered so that it will strike the next ring of moving blades at the required angle. The guide blades are so shaped as to effect this purpose. In order to use steam economically it must be worked expansively, and this problem Hon. C. H. Parsons has solved in this way. As the steam does work, it necessarily increases in volume, and loses proportionately in pressure; to accommodate the increased volume additional blade area is given by gradually increasing the annular space and the size of the blades. Though its action in each individual turbine is approximately as if the fluid was inelastic, yet a small increment of volume takes place at each passage through the blades, and the expansion going on at something like geometric ratio at each of the numerous successive turbines, soon assumes large proportions. Ratios of expansion of fifty up to one hundred or even two hundred-fold are common in one single compound turbine of the condensing type—a notable feature in turbine practice being the high expansion ratios, and very large volumes can be economically dealt with without necessarily increasing the size and weight of the engine to any large extent.

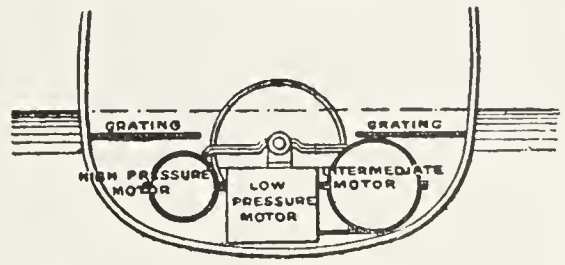
The high speed of revolutions diminished not only the weight of the engine in proportion to a given h.-p.; but also of shafting propellers and supports, as well as of the hull.

The inventor makes the following claims for the new motor: Greatly increased speed, owing to diminution of weight and smaller steam consumption; increased carrying power of vessel; increased economy in coal consumption; increased facilities for navigating shallow waters; increased stability of vessel; reduced weight of machinery; reduced cost of attendance on machinery; reduced size and weight of screw-propellers and shafting; absence of vibration; lowered centre of gravity of machinery, and reduced risk in time of war.

The "Turbinia" is 100 feet in length, 9 feet beam, 3 feet draught amidships, and 44½ tons displacement. She has three screw shafts, each directly driven by a compound steam turbine of the parallel flow type. The three turbines are in series, and the steam is expanded (at full power) from a pressure of 170 lbs. absolute, at which it reaches the motor to a pressure of 1 lb. absolute, at which it is condensed. The shafts are slightly inclined, and each carries three screws, making nine in all. The screws have a diameter of 18 inches, and when running at full speed they make 2,200 revolutions per minute. Steam is supplied from a water-tube boiler, and the draught is forced by a fan, mounted on a prolongation of the low pressure motor shaft, the advantage of this arrangement being that the draught is increased as the demand for steam increases, and also that the power to drive the fan is obtained directly from the main engines. Up to the present the maximum mean speed attained has been 32¾ knots, as the mean of two consecutive runs on the measured mile. These runs



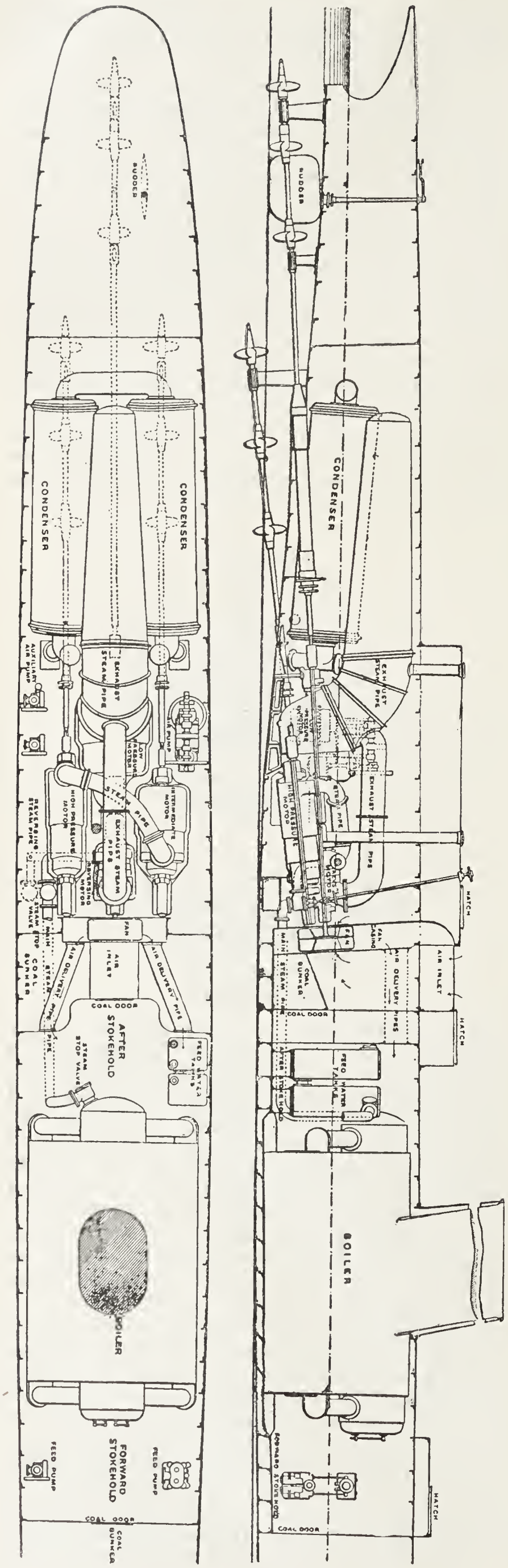
SECTION THRO' ENGINE ROOM LOOKING AFT.




SECTION THRO' MOTORS

were made after about four hours' steaming at other speeds, and the boat on the day of the trials had been fifteen days in the water. It is anticipated that on subsequent trials, after some alterations to the steam-pipe, still higher mean speeds will be obtained. As it stands, however, the I.H.P. realized is 2,100, and the consumption of feed-water per I.H.P. hour 14½ lbs, and the speed the fastest of any vessel irrespective of size. The weight of the main engines is 3 tons 13 cwt. Total weight of machinery, including turbines and auxiliary engines, condenser and boiler, the propellers and shafts, the tanks and the water in boiler and hot well, 22 tons. Thus nearly 100 h.p. is developed per ton of machinery, and nearly 50 h.p. per ton of displacement of boat. The total weight of the "Turbinia's" engines is 3 tons 13 cwt., and they develop 2,100 indicated horse-power, as determined by Professor J. A. Ewing, F.R.S. Ordinary navy engines of the torpedo vessel class would weigh probably 15 to 20 tons.

"The advantages of a rotary-motor for the purpose of marine propulsion are manifest as regards a direct application of the force of the steam to the shaft to be driven, and a consequent saving of bulk, weight, friction and wear," says the *Marine Engineer*, London, in a recent article. 'When such a motor is shown to be economical in steam




construction, and that the power delivered by the motor at a high speed of rotation can be economically transformed into thrusting power by the screw propeller, and that the whole of the machinery is simple and easy to work, the position of the rotary-motor becomes well established as a rival of the reciprocating engine, provided there are no drawbacks to detract from the advantages which it manifestly possesses. Up to the present no such drawbacks have shown themselves, or seem likely to."

"The 'Turbinia,'" says *Engineering*, of London, "which, at the special request of the admiral in command of the fleet, made a run at full speed through the lines at the great naval review, is so novel a vessel that in spite of the remarkably successful results achieved by her, it would be difficult to say to what she will lead. Certainly it is a very long step forward to imagine steam turbines taking the place of the ordinary reciprocating engine in heavy vessels. But if the difficulty at present attendant on going astern can be overcome, it can hardly be doubted that for very high-speed craft the new system will find a conspicuous place in warship design, in spite of the multiple screws and the high rate of turning."

New principles, whose application seems likely to have such great influence in the future development of naval architecture, have not escaped the notice of the leading shipbuilders and owners of Canada. The Richelieu and Ontario Navigation Co., as noted in THE CANADIAN ENGINEER recently, has during the past couple of months examined the Turbinia model, with a view to its possible adoption for their new steamers.

## INSTRUCTION IN PRACTICAL SCIENCE.

Discoveries made in the past ten years have materially changed the problems which civil engineers are required to solve and changed problems demand enlarged equipment for their solution. The department of the waterworks engineer has been most materially affected by recent discoveries. Formerly water supplies and sewage works were matters of construction and hydraulics. The water supply was obtained as pure as possible, and pains were taken to maintain that purity. The sewage was filthy and its condition was a hopeless matter—it was "disposed of" in "disposal" works or poured out to contaminate the water supplies of other places.

It is now established as a fact by scientific research that the dangerous elements of impure water and sewage are largely the same, are caused in fact by the presence of certain bacteria. These bacteria cannot continue to exist in the presence of certain other classes of bacteria, and the problem of water purification to-day is solved by the most advantageous bringing together of these various classes of bacteria.

It does not ordinarily lie within the sphere of the duties of a civil engineer to make cultures of bacilli, but if his practice is to include public water supplies and sewage works, he should possess sufficient knowledge of the general principles of biology and enough of bacteriology to know what should be done to determine the sanitary condition of the water he is dealing with and the effluent from his sewage disposal works. In order that a civil engineer shall be professionally qualified either to design some modern water supply and sewage-disposal works, or to maintain and operate them, it is absolutely essential that he should have suitable biological training in the school of civil engineering. How many of the civil engineers who have been instructed in our expensively equipped schools of science have ever heard of the bacteria of putrefaction, or who would know a microbe if they saw it with the aid of

the most powerful microscope. For example, do the students of the School of Practical Science, Toronto, an institution maintained by the Ontario Government, ever avail themselves of the lectures given during the college term by the faculty of the Biological Department of Toronto University, which is also maintained by the Ontario Government? We are unable to find any record their having done so.

While discussing this general subject we must refer to a paper by George C. Whipple, in the *Proceedings* for 1896 of the Society for the Promotion of Engineering Education, on "Biology for Civil Engineers." He points out the fact that the science of biology has intimately touched the profession of civil engineering in water supply and sewage practice, so that the educational training of a civil engineer can no longer be considered complete without a suitable grounding in bacteriology. In this he is undoubtedly correct. He pointedly observes that filters, which civil engineers must now design and operate as prominent features of both water and sewage treatment, are not mere strainers but immense colonies "of organisms whose one object in life is to convert the decomposable matter * * * into harmless nitrates." The bacteriological laboratories connected with the waterworks of Boston and of Brooklyn, to say nothing of others, show clearly what must of necessity be the trend of civil engineering education in relation to this matter, and the excellent work already done by civil engineers in the same line at Boston and other places demonstrates the correctness of the views we have expressed.

## ANALYSIS OF NOVA SCOTIA COALS AND OTHER MINERALS.

BY E. GILPIN, JR., LL.D., F.R.S.C., INSPECTOR OF MINES, HALIFAX, N.S.

A set of analyses of coals from the three seams worked at Springhill by the Cumberland Railway and Coal Company were given me some months ago. They are made by J. T. Donald, Montreal, and were taken from the workings at a depth of from 800 to 1,000 feet. These analyses are interesting when compared with a set of analyses of the same seams made by me in the year 1881, and I believe not hitherto published, and with an analysis of the Black seam made by me in the year 1880, and published in the "Transactions of the North of England Institute of Mining Engineers," in a paper on "Canadian Coals," giving a full set of analyses of Nova Scotia coals, their ashes, etc.

East or No. 1 Slope—Black or Main Seam:

| | Analyses made in 1897. | Analyses made in 1881. |
|---|---|---|
| Moisture | 2.02 | 3.86 |
| Volatile combustible matter | 18.94 | 35.65<br>26.46 |
| Fixed carbon | 75.29 | 59.90<br>65.23 |
| Ash | 3.75 | 4.45 |
| | 100.00 | |
| Sulphur | 1.14 | |

West or No. 2 Slope—South Seam:

| | | |
|---|---|---|
| Moisture | 1.41 | 1.399 |
| Volatile combustible matter | 27.93 | 34.808<br>31.225 |
| Fixed carbon | 67.47 | 58.003<br>61.586 |
| Ash | 3.19 | 5.790 |
| | 100.00 | |
| Sulphur | .58 | .808 |

North or No. 3 Slope—North Seam:

| | Analyses made in 1867. | Analyses made in 1881. |
|---|---|---|
| Moisture | 2.71 | 1.625 |
| Volatile combustible matter | 28.41 | 33.401<br>28.672 |
| Fixed carbon | 64.69 | 60.701<br>65.431 |
| Ash | 4.19 | 4.272 |
| | 100.00 | |
| Sulphur | .79 | .783 |

Analyst—J. T. DONALD, *Montreal.*

These analyses show the coals to be of excellent quality. The amounts of ash and sulphur are small, and that of the fixed carbon is large.

From a comparison of the later with the older analyses it will be seen that those of coal from the deeper portions of the seams show lessened amounts of volatile combustible matter, increased percentages of fixed carbon, and diminished amounts of sulphur and ash. Speaking in general terms, the coal would appear to have developed more into a steam fuel, the evaporative power being in a general way proportionate to the percentage of fixed carbon. This would give the coals as at present mined a high calorific power. From analyses by Mason and Matheson in a paper read before the Nova Scotia Mining Society, it would appear that the calorific powers of coals from the Sydney coal fields vary from 7238 to 7623; of Pictou coal (sample from Intercolonial mine), 6963, and of Springhill coal, 7898. As compared with United States coal, they should stand nearly in the rank of the best free burning coals of Pennsylvania, Virginia and Maryland. Those coals hold from 12 to 21 per cent. of volatile matter, and from 69 to 76 per cent. of fixed carbon. The average contents of the United States coals are from 29 to 35 per cent. of volatile matter, and from 53 to 67 per cent. of fixed carbon. These coals therefore from Springhill should rank for steam purposes next to the class which may be described as the best selected for use on the large ocean passenger vessels.

I have not at hand any proximate analyses of English coals to compare with these under consideration. However, taking the results obtained in the English Admiralty trials of steam coals, and comparing the percentage of fixed carbon found in the trials with the fixed carbon given in these analyses, it will be found that the English and Scotch coals run from 49 to 88 per cent., as compared with 68.2 per cent. in the Springhill coals. This would give the Springhill coal about the same relative position to the best Welsh coals as has already been assigned to it in comparison with the best American coals. The evaporative power of the Springhill coals would, from the analyses, stand higher than that of the English and Scotch coals, and rank next to that of the best Welsh steam coals. It may be remarked that the best American and Welsh coals would be classified as free burning, semi-anthracite, while the Springhill coals are bituminous and coking.

In the upper part of Georges River in Cape Breton county there is a large deposit of iron pyrites in rocks, which are, I think laid down as Laurentian by the Geological survey. The deposit has as yet been examined only superficially, but so far appears somewhat low in sulphur. The following analysis from the most promising exposure gives:—

| | |
|---|---|
| Sulphur | 25.00 |
| Copper | 1.10 |
| Gold | Trace. |
| Silver | Trace. |
| Silica | 52.00 |
| Iron, etc. | 25.00 |

For a number of years the presence of iron ore at Whycogomah in Cape Breton has been well known. The ores, which are magnetites and red hematites, are so very favorably situated, being close to the waters of the Bras d'Or Lake, that a good deal of work was done on them a number of years ago. A number of beds were opened and traced. They varied up to nine feet in thickness, and occurred in the limestone division of the Laurentian, as described by Mr. Fletcher in his numerous reports on the geology of Cape Breton, issued by the Survey. The analyses of the ores were contradictory in character, some being high in phosphorus, while others were very pure and ran high in iron. Last fall fresh discoveries were made in this district some distance from the old openings, of beds of magnetite, some upwards of 100 feet in width. Indications are not wanting that these ores extend over a large tract of country.

The following analysis will serve to show the quality of the ores :—

| | |
|---|---|
| Silica | 14.41 |
| Alumina | 7.33 |
| Manganese oxide | .61 |
| Lime | 3.00 |
| Sulphur | .22 |
| Metallic iron | 54.50 |
| Phosphorus | Trace. |
| Magnesia | Trace. |

| Iron. | Phosphorus. | Sulphur. |
|---|---|---|
| 55.70 | None. | .68 |
| 59.60 | .16 | .23 |
| 63.20 | .004 | .31 |
| 54.30 | .005 | .38 |
| 53.20 | .38 | .25 |
| 50.74 | .31 | .024 |
| 53.12 | .28 | .026 |
| 52.85 | .0058 | .138 |

| | |
|---|---|
| Silica | 21.05 |
| Ferric Oxide | 53.54 |
| Ferrous Oxide | 21.24 |
| Alumina | 2.26 |
| Manganese Oxide | .50 |
| Lime | 1.17 |
| Magnesia | .36 |
| Sulphur | .023 |
| Phosphorus | Trace. |
| Metallic Iron | 54.00 |

| | |
|---|---|
| Metallic Iron | 54.36 |
| Phosphorus | .38 |

| | |
|---|---|
| Silica | 13.00 |
| Metallic Iron | 55.70 |
| Sulphur | .68 |
| Phosphorus | Trace. |

These analyses show that there are ores in this vicinity valuable enough for shipment as regards quality, and the present owners consider that new explorations now being carried on will show that the ore is present in quantities sufficient to warrant working on a large scale. In this connection reference may be made to this division of the Cape Breton Laurentian in which these deposits occur. It may be distinguished as the limestone division, as it is distinguished mineralogically from the other, or felsite division, by the presence of numerous beds of limestone, in addition to the felsites, gneisses, granites, etc., common to both. These limestones furnish marble, as at West Bay and other localities, lime of excellent quality, and dolomites, suitable, as at New Campbellton, for furnace linings. Iron ores occur in them at numerous points both hematite and magnetite. Graphite is also found. In all probability, phosphates similar to those found in Quebec will be proved on search being made. Where these measures are cut by dykes, copper and lead ores carrying gold and silver occur, and may in some cases prove valuable. As yet, so far as my information goes, free gold has not been found in quartz in the limestone division. The gold of Middle River and Cheticamp appears to be associated with soft talcose and felsitic schists of the other division. This gold occurs at Middle River free in quartz and in the river gravel derived presumably both from the quartz and augmented by gold flakes from the schists. At the Cheticamp River, so far as can be judged from the work done, it would appear to have a similar source, and to be connected only with the felsite series. In the latter case part of the gold may be derived from mineralized zones adjoining the dykes cutting the various rocks. However, the explorations of the coming season will probably give us more exact information. It is interesting to note in connection with the occurrence of gold at Cheticamp that native silver occurs in the Mackenzie River a short distance north, and it is possible that explorations in that section may result in the discovery of important amounts of this metal and associated gold.

## THE GREAT LAKES AS A SENSITIVE BAROMETER.*

BY F. NAPIER DENISON, METEOROLOGICAL SERVICE OF CANADA.

For many years fishermen and sailors upon our great lakes have noticed with interest and curiosity the rapid rise and fall of the water, most marked at the head of shallow lagoons or bays, and have considered it to be an inexplicable phenomenon. While in the vicinity of Lake Huron last summer the writer's attention was attracted by what appeared to be a regular ebb and flow at the mouths of rivers. At Kincardine, by means of a special float, a set of readings was taken, and a variation of level of over three inches observed, averaging nine minutes, that is eighteen minutes for a complete undulation. The weather at the time of observation was fine and excessively hot, but during the night the town was visited by a severe thunderstorm. During the same day at Goderich, a few miles distant, regular undulations of six inches amplitude were reported. From these and other observations, it appeared as if these undulations might be caused in some yet unknow nmanner by differences of atmospheric pressure upon the surface of the lake.

Upon returning to Toronto and discussing the matter with the Director of the Meteorological Service, he authorized me to proceed with the investigation as part of the regular work of the service, supplying the funds for the construction of such instruments as appeared necessary in a preliminary examination of lake undulations and atmospheric waves. An instrument was set up at the mouth of the Humber River, near Toronto, where ever since most interesting results have been obtained.

The following is a brief description of this instrument: It consists of a recording cylinder placed horizontally, which by means of clockwork completes one revolution every 24 hours. Resting upon this is a self-inking pen attached to an arm which slides freely upon a horizontal guide. This arm is connected by a line to the float, which is enclosed in a special shaft, so constructed as to admit the water only through several small holes; this prevents any sudden movement of the float being caused by local wave motion. As the float rises and falls, the pen correspondingly moves up and down upon the paper, which is revolving at the rate of one inch per hour. The ratio of movement between pen and float is as 1 to 4, so that a rise of one inch of water level corresponds to a movement of one-

*A paper read before the meeting of the British Association for the Advancement of Science, held in Toronto.

quarter of an inch upon the paper. One-quarter inch squared paper is used, the vertical lines marking fifteen minute intervals and the horizontal one-inch change in water level. To prevent the water freezing in the shaft during the winter months, oil was used, which had the effect of depressing the water level below the frost line.

In order to increase the value of these records, a similar instrument was set up at the Burlington Canal last September. Before bringing before you some interesting tracings taken from these instruments, permit me to summarize previous investigations in other countries.

This phenomenon had been noted by Duillier as early as 1730, upon the Swiss lakes, where it obtained the name of seiche, owing to the apparent "drying up" or recession of the water upon one side of the lake, when rising at the other. In 1779, De Saussure remarks that he believes local variations in the air pressure may be the cause. Vaucher supposed that the atmospheric pressure diminished over one part of the lake, while over another it remained constant or increased. If this change in pressure occurred suddenly, the water which had thereby been set in motion would not come to rest again until after a number of oscillations. Professor Forel agrees with this theory, which has also been accepted by Studer, Meyer and Favre. From 1854 to 1856 an important series of observations were made by six observers, placed at different points upon the shore of Lake Geneva, who, using a system of signals to warn each other of the approach of an oscillation, noted the variations of the barometer and of the lake level. As Professsor Forel, in his article, entirely disregards these barometric observations, they do not appear to have been published.

In 1876 Forel set up an automatic instrument to register these movements, and from records extending over four months he deduced the existence of three varieties of seiche, viz., transverse, duration 10 minutes; longitudinal, duration 70 minutes; intermediate, duration 25 minutes. Upon this instrument he also observed movements of what he terms "vibration" caused (1) by steamers. The interval between these is from 9 to 60 times greater than that between ordinary waves, and they preceded the approach of a vessel by about 25 minutes, or when it was $9\frac{1}{2}$ kilometres distant, continuing for two or three hours afterwards. (2) By wind, having no regular time or rhythm, and varying in amplitude from nothing to 10 millimetres, and in duration from 45 seconds to three or four minutes. He remarks that "sometimes there are little or none with a strong wind."

Lord Kelvin gives a theoretic law for the duration of these seiches in any lake, viz.: the semi-period of an oscillation is equal to the time that a body, travelling at the rate which it would acquire in falling from a height equal to half the mean depth of the lake would take to traverse the length of the lake. Thus, the duration of a seiche is proportional to the square root of its mean depth. (Archives des Sciences Naturelles, Geneva, 1876). Applying this to Lake Ontario, and assuming the mean depth to be 300 feet, we obtain a theoretical duration for a longitudinal seiche, of over five hours. As will be shown later, the mean interval between the longest undulations, as taken from the Humber traces, is about 4 hours and 49 minutes. In 1880 Professor Forel, in a letter, states that the smaller and more rapid oscillations may be accounted for by dividing the lake surface into more than one nodal point. (Archives des Sciences Naturelles, Geneva, 1880). Mr. Crosman in his valuable charts of the great lakes refers to the existence of a "seiche" movement similar to that observed upon the Swiss lakes. He also states that when the lakes are undisturbed by the action of the wind, a regular series of small waves can be detected, which have a marked time interval of ten minutes. These pulsations appear on Lake Superior almost without cessation. Lastly, H. C. Russell, of Sydney, New South Wales, has studied these oscillations at the south end of Lake George by means of a self-recording gauge, and has obtained longitudinal seiche movements whose amplitude is about four inches, and time interval two hours and eleven minutes.

As the chief object of this paper is to demonstrate the direct action of the atmospheric waves upon the water, permit me to dwell for a moment upon the movements of the upper strata of our ocean of air, "at the bottom or on the shoals of which we live," as Humboldt so poetically says.

The late Professor Helmholtz, of Berlin, who has made a special study of atmospheric waves from theory and analogy with ocean waves, has clearly demonstrated the existence of huge waves or billows in the atmosphere like the waves in the ocean, which are due to friction between atmospheric strata of different densities, moving in different directions and with varying velocities. He also states these waves may be of all sizes from the minutest ripple to the gigantic billows which affect the barometer at the bottom of this ocean.* This theory is sustained by Professor Langley, of Washington,† and by Mr. Clayton, of the Blue Hill Observatory. The latter has also shown that the larger waves, as marked upon the barograph traces, have a maximum frequency with north-easterly winds, and a minimum frequency when the wind is from the south-west.‡ The chief point of origin of these waves appears to be at the lower boundary surface of the upper or poleward current which travels approximately from the south-west to the north-east in its spiral course around the globe. Its average summer velocity at this latitude is 60 miles per hour, which increases to 112 miles per hour during the winter months. When the lower stratum of air is travelling in an opposite direction to the superincumbent upper current, huge waves or billows are set up between these rapidly moving opposing currents, which are of different densities. Such conditions would exist during the approach of a cyclonic storm from the south-west. The influence of these huge waves extends to the earth's surface, where they have been recorded upon barograph traces. Other forms of wave movement in the lower air stratum (say cumuli level) may be caused by two subsidiary strata travelling at velocities and in directions differing from one another, as may often be observed during the approach of an important storm centre. These waves also extend to the earth's surface, and are recorded upon the barograph traces as short and rapid undulations.

Under certain conditions the existence of these atmospheric waves may also be observed in the cloud formations; for instance, during fine anti-cyclonic weather, one has frequently noticed great parallel bands of cirri clouds appear in the west, and rapidly extend eastward in advance of a severe storm. These represent the crests of the larger or primary billows mentioned by Helmholtz, and are caused by the lower denser stratum of air being forced up into a lighter and cooler level, where condensation takes place.

In order to pursue the study of the still smaller atmospheric undulations, which cannot be discerned upon the ordinary barograph, a simple form of self-recording air barometer was constructed and set up at the Observatory,

* From the Sitzungs-berichte of the Royal Prussian Academy of Sciences at Berlin, July 25th, 1889.

† Internal Work of the Wind, Smithsonian Contributions, 1893.

‡ Blue Hill Meteorological Observations, Vol. XL., Part III, Appendix E, 1893.

the scale value being 17 inches to 1 of mercury. To obtain a definite knowledge as to the manner in which the waters respond to the atmospheric pressure changes, the lake records and corresponding sensitive barograph traces have been tabulated in conjunction with the bi-daily synoptic weather charts, under the following headings :—

LAKE RECORD.

| Date. | Time 8 a.m. 8 p.m. | Amplitude In Inches. | Time Interval 7-8 | 8-9 | Condition during last 12 hours. Amplitude. | Mean Time Interval. |
|---|---|---|---|---|---|---|

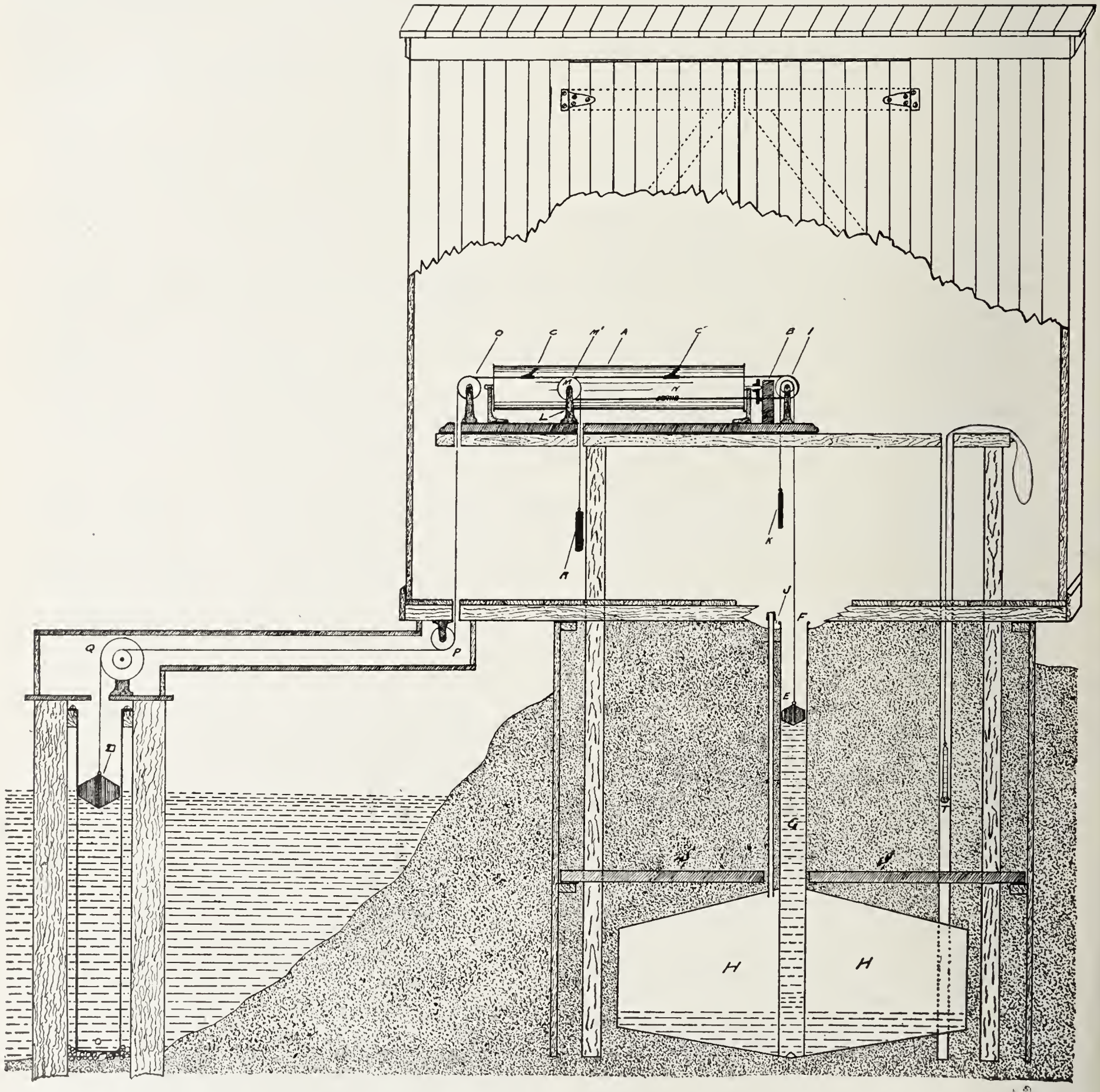
AIR BAROMETER.

| | | Amplitude In Inches. | Time Interval 7-8 | 8-9 | Condition during last 12 hours. Amplitude. | Mean Time Interval. |
|---|---|---|---|---|---|---|

Position of Lows and Highs, with barometer readings at their respective centres ; barometer reading, weather wind and precipitation at Toronto, and remarks column

As the information obtained from these tabulations has clearly shown a marked correspondence between the air and lake movements, the writer has recently devised a simple instrument to record both undulations upon the same time sheet. This now supersedes the former instrument at the Humber.

The following is a brief description of this instrument as shown above, which is placed in a specially constructed house close to the water's edge : *A* is a cylinder, three feet long by twenty-four inches in circumference, which, by means of the clock *B*, completes one revolution every twenty-four hours. Upon this cylinder rest two self-inking pens *C* and *C'*, whose movements (though impossible to show in the above section) are quite independent of each other. *C* is actuated by the lake level float *D*, and *C'* by the float *E* in the air barometer *F*. This barometer consists of a vertical pipe *G*, four inches in diameter which passes




HYDRO-AEROGRAPH.

down through, and is attached to the bottom of a cylindrical air chamber *H*, four feet in diameter, constructed of a heavy gauge of steel. This chamber is hermetically sealed with the exception of two small holes at the bottom of the central pipe *G*. To complete this instrument, water is poured into the central pipe *G*, until the confined air in *H*, is compressed sufficiently to sustain a column of water,

upon which the float is placed. When the external atmospheric pressure increases upon the surface of the column of water in *G*, more water is forced into *H*, thereby reducing the height of the central column and increasing the compression of the confined air. When the external atmospheric pressure becomes less, the reverse action takes place. In order to prevent variations due to sudden temperature changes, the chamber *H* is buried five feet below the ground level, which in this case is also below the level of the water. The daily reading of the soil thermometer *T* gives a constant record of the temperature at this depth. To facilitate the sinking of the chamber *H* below the surface of the water the confined air was expelled by removing the cap from the small pipe *J*, and pouring water into the central pipe until *H* was filled. After filling in the sand to the top of the chamber *H*, double planking *S* was laid across from shoulder to shoulder of the curbing to prevent any variable strain on the top of H, due to changes of atmospheric pressure upon the earth's surface directly above. To put the barometer in working order the water was all pumped out, then after screwing the cap on the pipe *J*, sufficient water was again poured into the central pipe *G* until it had risen as shown by the dotted lines. To prevent evaporation the top of the column may be sealed by a suitable form of oil. Referring again to the recording portion of the instrumet *I* is a double grooved pulley placed between centres. Upon its smaller grooved circumference rests a line which has one end attached to the barometer float *E* and the other to a counterbalance weight at *K*. *L* is a standard supporting two grooved pulleys *M* and $M^1$ of similar diameter. Pulley $M^1$ which is obscured by *M* in the section is connected to the pulley *I* by a fine line kept taut by means of an adjustable spiral spring at *N*. To overcome friction the barograph pen $C^1$ is attached to a slender aluminum arm, which in turn is connected to a fine aluminum sleeve fitting tightly upon the line in such a manner as to permit a free vertical, but not horizontal, movement on the sleeve. The lake level recording pen *C* is attached in a similar manner to the line which starts from the smaller grooved circumference of the pulley *Q*, and passes over pulleys *P*, *O* and *M*, terminating in the counterbalance weight *R*. To prevent errors due to changes in the length of the line between float and pen, a fine plated steel wire was used from *Q* to *P*, and a special flexible material from this to the instrument. The recording sheet is ruled into one-quarter inch squares. Two feet upon the cylinder is allowed for the barometric range, and one foot for the lake level changes, and as the ratio of movement between pen and float remains the same as previously described (viz., 1 to 4), a range of twelve inches on the cylinder would correspond to a change of water level of forty-eight inches. Both pens are set in line in order that their times will exactly agree, also the barometric pen under increasing pressure is arranged to move up the paper in the same direction as the lake level would assume during a rise of the water. The object of this instrument is not so much to furnish a very accurate measurement of the atmospheric pressure changes, as are now obtained from the more expensive mercurial and aneroid barographs, as to magnify these movements to enable one to study the characteristic forms and extent of the ripples, waves or billows, which have lately been found to exist in our atmosphere during almost all conditions of weather ; also as a means of proving conclusively to what extent, and in what manner these atmospheric disturbances affect the waters of the lake. As this appears to be the first instrument of its kind the writer ventures to term it a hydro-aerograph.

*(To be Continued)*

## THE GREAT NORTH.

A railway to the shores of James Bay or Hudson Bay is not only quite feasible, but it is urgently needed to develop the resources of our great North Land. For the past century and a half furs have been the great staple of trade in this region of Canada, but there are many sources of wealth about Hudson and James Bays, and some of these can only be drawn upon by means of a railway. Take the marine products alone. "The salmon," says an official report, "abound in the streams running into Hudson Strait so plentifully that a ship can be loaded with them in a few days. They are pronounced the finest in the world—much better in quality than those in the Pacific or those in the more southern waters of the Dominion." The same is said of the trout. The bay teems with other fish, such as cod, hake, pollock, whiting, etc. For many years American whalers have resorted here, and returns to the United States Fisheries Department show that the value of the "takes" of fifty whaling voyages there have aggregated $1,371,000, or $27,420 per voyage—a statement which ought to attract the attention of some of our Canadian sea fishing men who complain of bad seasons on the Atlantic. United States fishermen in the last ten years have taken out of Hudson Bay in fish oil and whale oil alone an average value of $150,000 a year ; while the Hudson Bay Company get over $50,000 a year from the blubber of the whale and porpoise. The narwhal, the walrus and the hair seal form very valuable sources of trade here. Of the porpoise alone, C. R. Tuttle, who accompanied the Dominion Government expedition in 1884, says : "I do not overstate the truth when I say that with proper facilities 4,000 or 5,000 of these oil-bearing animals could be taken at one place in a single season, which means blubber to the value of over $300,000." A railway to James Bay would pay, looking to the development of the fisheries alone, but these are only an element in the case. Countless millions of feathered game can be obtained here, such as wild geese, ptarmigan, curlew, and ducks. There are three or four varieties of wild geese and over a dozen species of duck, among which may be noted the eider duck, which produces the eider down so valuable in commerce. Leaving out of question the fur trade, which is still of immense value, it is to be noted that the country from Michipicoten north to James Bay is rich in minerals, though the real value of the minerals can scarcely be said to have been investigated. From the cursory trips of geologists and travellers we know there are deposits of gold, silver, molybdenum, galena, iron, mica, coal, graphite, asbestos, zinc, fire clay, salt, gypsum, copper and ornamental stones. Dr. Bell was struck with the fine specimens of pure copper pyrites, and of manganese iron ore. It would only be repeating the history of other regions, if the building of a railway would of itself lead to the opening up of new mineral beds not yet known to exist. Vast tracts of the country between the Ontario lakes and Hudson Bay are heavily timbered, and the spruce is of magnificent growth and excellent quality for pulp making. The pulp industry by itself would afford traffic in a few years for such a railway. Lastly, as to agriculture, it may not be generally known that the climate of the region in question is in the main as temperate as that of Manitoba, as the meteorological records at Moose Factory show, and "the gardens of Rupert's House, East Main and Fort George show that potatoes and all the ordinary vegetables thrive well." The Hudson Bay Co. maintain a stock farm at East Main, where cattle and sheep thrive well.

The subject of a railway to James Bay is just now engaging the attention of people both in Ontario and Quebec. The scheme for a road there from Toronto was outlined in our August number. In Quebec, Charles Baillairge has proposed a route starting at the present terminus of the Lake St. John Railway, and running up the valley of the Chamouchouan, thence across the height of land and down the Waswanipi and Nottaway rivers, reaching the Bay at Rupert's House. This route is endorsed by Henry O'Sullivan, Inspector of Surveys of the Province, who has been over the ground, and who more than confirms the statements we have made regarding the natural resources of the Hudson Bay region. Mr. O'Sullivan gives an interesting account of his explorations in the "Bulletin of Geographical Events of Quebec," just published. A committee of this society have drawn up a memorial to the Provincial Government of Quebec, urging the extension of the railway from Lake St. John to James Bay, without committing themselves to any route. They mention as an alternative route that *via* the Chamouchouan and Hannah rivers, the latter being west of the Nottaway. Information in the possession of the society goes to show that wide stretches of country along these routes possess a wonderfully rich soil, with a climate as favorable as that of the Lake St. John valley, which is now being steadily and successfully colonized. The distance from Roberval to Rupert House is only about 360 miles, and the highest point of land is only 900 feet above the altitude of Roberval. The mean grade from the height of land down to the Bay is only five feet in a mile, which makes the problem of construction very easy. The building of a railway to James Bay from Ontario or Quebec, or both, is well worthy the attention of capitalists, and the encouragement of Government.

The promoters of a railway from Toronto to Hudson Bay have surely made a blunder in tacking to it a suppositious navigation—beginning at the north end and proceeding, with an intervening railway stretch, from the west end of the Chesterfield Inlet, so called, but which is really the lower end of a long water course—to the Thlew-ee-cloh or Great Fish River. The assumption is of course that this river is or can be made navigable, at a cost which it would be possible to meet. The promoters must also assume that the waters beyond the Thlew-ee-cloh are so far navigable as to serve as a means of getting towards the Klondike. These assumptions are absolutely contrary to the fact. Some parts of the waters along this immense distance do provide the means of navigation for almost any kind of craft. Of the whole length of these water stretches the Mackenzie River is the best.

But what is the character of the Thlew-ee-cloh? Capt. Back, who, acting under instructions from the British Government, went along the whole course of the river from its source to the Arctic Ocean, in 1834, is the best, if not the only authority. His account of the river is very different from the imaginings of the gentlemen who, with a light heart and triumphant mien, talk of making it a link in the road between Toronto and the Klondike. "The Thlew-ee-cloh," Capt. Back, as the result of this special inspection, made under almost insurmountable difficulties, informs us, "after a violent and tortuous course of 530 geographical miles, running through an iron ribbed country, without a single tree on the whole of its banks, expanding into fine large lakes, with clear horizons most embarrassing to the navigator, and broken into falls, cascades and rapids to the number of no less than 83, pours its waters into the Polar Sea in lat. 67° 11′ 00″ N., longitude 94° 11′ 00″ W. Some of these obstructions occur below the point at which a railway from what, until the nomenclature is reformed, in accordance with recent discoveries, we must continue to call Chesterfield Inlet, would strike the Thlew-ee-cloh, but there are enough of them above to make the river unnavigable, by any expense which it would be rational to conceive possible or any delay of time which could reasonably be expected to be made by travellers on this route. This water route would take the pilgrim on his way to the Klondike some 200 miles too far south, at Great Slave Lake, and as he would have to go north again an equal stretch, the whole deviation would be 400 miles.

Between the Thlew-ee-cloh and Great Slave Lake the character of the navigation does not improve. Before Great Slave Lake could be entered, on the upward voyage, Parry's Falls, nearly twice the height of Niagara, would have to be overcome. Captain Back states this fall to be "between four and five hundred feet."

And how long would the waters on this route be open in each year? Captain Back started at the source of the Thlew-ee-cloh, on his downward voyage on the 28th June, and arrived, on his return, at the same place, Sept. 17th, having met much hindrance from ice most of the time. At what date in the summer does the ice in Chesterfield Inlet break up? What would be the length of the season of navigation on this route, if it were possible to establish any navigation that would serve as a suitable adjunct to railway travel?

Some one connected with the promotion of this amphibious railway project ought to give his days and nights to the study of the geognosy of the region to be traversed.

## AN IMPROVEMENT IN GOLD MILLING PROCESSES.

The richest gold mines are not always the most profitably worked, as there is often more made from a mine in which the gold in the ore can only be economically recovered by the most exact processes. In Canada, so far, development has been largely confined to ores which are rich enough to yield profits without too expensive plants or too complicated processes. We must, however, seek on every side for improvements which will enable us to take profits from more of our low-grade ores and from our less advantageously situated leads.

Great economy in the water supply for gold milling is made possible by an improvement in milling processes described in a recent issue of the South African *Mining Journal*. Much difficulty has recently been experienced on the Rand through the scarcity and muddiness of mill water. Careful practice under working conditions and on several mines has finally established beyond dispute that one of the details of a slimes process—the admixture of a small percentage of slaked lime with the slimes-pulp—is a complete preventative of muddiness in mill water; and it may be taken for the future as one of the fundamental axioms in mill practice that no gold mill need suffer loss or inconvenience from scarcity of water if it has a supply sufficient to circulate through the battery, tailings plant, and slimes plant, and can make good a diminution of about 5 per cent. in that supply during the month's working.

In employing this process, about $5\frac{1}{2}$ lbs. of finely-divided slaked lime are added to the slimes pulp for every ton of solid slimes contained, and within $2\frac{1}{2}$ hours a large proportion of the water contained in the slimes-pulp is delivered back to the mortar-boxes clarified from all sediment, and having an appreciable alkaline reaction. As a rule the mill-pulp is separated, the sands being collected for cyaniding, and the slimes running away to the slimes-

dam, where it is sometimes weeks before the water becomes clarified, and where there is a loss by evaporation, leakage, etc., of never less than 25 or 30 per cent., and often more. Moreover, heavy pumping charges have to be incurred for the purpose of returning the still somewhat turbid water from the slimes-dam to the mill, as well as for the purpose of making good the serious loss by evaporation, etc.

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*For* THE CANADIAN ENGINEER.

## FIRE FIGHTING.

BY EXTINGUISHER.

Having some experience in the business of extinguishing fires, handling, drilling, and leading fire brigades in one of the British towns, and having for about a dozen years resided opposite one of the Toronto fire halls, I feel that I am in a position to make comparisons between the two systems. I have noticed that in nearly every large fire there is an unnecessary destruction of property, and damage to the extinguishing apparatus, and either through carelessness, recklessness, or questionable management, there is a large number of accidents and considerable loss of life, which offsets the good done by the brigade in staying the flames.

The system adopted in Toronto of compelling men to loaf their time away in a lazy fashion reduces their energy and efficiency, causing them to do their work, when it comes along, in a jerky, impulsive way, and when the brain is most needed it is often dull and inactive, on account of being underworked or undisciplined. Some five years since I was at a convention in London, Ont., when the mayor gave a show by calling the brigade to the square opposite the Boswell House. The roads are wide, but too narrow for one of the reels, which struck the curbstone and pitched off the men, one striking his head against a sharp corner of the hotel wall. This was called an accident, but I am sure it was one that could have been easily avoided by proper drill.

There appears to be small chance in Toronto of proving that a fire has been started purposely to defraud, because of the custom of our firemen of breaking open doors and windows and letting in the air in large volumes, which at once turns a smoky, smoldering mass of burning material into a fierce and destructive flame; and where a few gallons of water intelligently sprayed on the smouldering mass would have destroyed the fire without injuring other goods, the fact of letting in more air than is necessary to do the work, often causes the gutting of the building.

When a fire is started by illuminating gas a small quantity of air let into the building will cause a fierce flame throughout the whole premises. Many valuable buildings have been destroyed by allowing unlighted gas burners to be turned on at full near the bottom of air hoist or staircase well, and a small light burning near the top. If the building be a large one, it may take a few hours to get the well or hoist shaft sufficiently charged with gas to ignite, when a sheet of flame will start on every flat, and if a good volume of air be introduced to feed the flame, the whole building is sure to be destroyed, together with the evidence of the way the fire started.

Steam is the best extinguisher of fires when soda, salt water, or other chemicals cannot be used. A volume of water is of little value until split up into small particles and made into steam by the fire on to which it is discharged. In all cases the water should be sprayed on under strong pressure, and wherever practicable, forced under or into the centre of the burning materials, because by so doing, the water will more quickly be turned into the steam needed to extinguish the fire, and no useless water will be discharged to run off and damage the surrounding goods and premises.

The men selected for the best brigades in the old country are mechanics, who thoroughly understand the details and construction of buildings; who are used to work and climb to giddy heights; men with nerve sufficient to walk across a fifty foot beam suspended high up in the air with safety. They are trained to attack a fire at points where the water will have a telling effect, and to avoid discharging useless water, or damaging property or goods unnecessarily.

Factories where they use steam boilers can put out the most dangerous fire by steam in about two minutes without damaging any machinery or goods.

Extinguishing fires is a fine mechanical science, and a good team of practical men can put out fires without hurry, fuss, or losing their wits. They have no preventible accidents or loss of life, nor do they damage any of the surrounding goods by flooding. In Canada a good team cannot be got. We require a good show in the street, and we are prepared to let a small blaze spread and destroy a whole block if our stations are carpeted and surrounded with costly appliances. The *men* engaged are the last consideration. We want to see spirited horses tearing through the street. It is of little importance whether good judgment and care is used by the men when in action. We are sympathetic when a fireman is lamed or killed, and never blame the men who placed him in danger, though his manifest unfitness for such a calling was a sure guarantee that his life and limbs were in constant jeopardy.

The old story can with reference to firemen be re-told, that a good workman or mechanic is very valuable, and of service to his fellow man, but a person who is wrongly placed and ignorant of the points and details of his work, is worse than useless, for he not only destroys the valuable appliances that are entrusted to him to use, but he endangers the lives of others as well as his own.

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## ACETYLENE.

The formation of a company in Montreal for the manufacture of calcium carbide and the extension of the works of the Willson Carbide Co., of St. Catharines and Merritton, are among the evidences that acetylene gas—at present the chief product of the carbide—is steadily making its way as an illuminant in Canada. Of course prejudice remains to be overcome and it is evident that the board of underwriters who have framed the code of regulations for the use of acetylene in insured buildings have much to learn about the nature of this gas. These regulations, which are quoted elsewhere, are vexatious without any apparent reason, unless they are designed to prevent the use of acetylene altogether. It is carefully provided that there shall be no chance to heat a building, and as all generators have some form of water seal, how is a building to be kept from frost in a Canadian winter?

One of the most comprehensive and instructive articles on acetylene we have seen in a long time is that in the *Engineering Magazine*, of New York, for August. After tracing the first discoveries of acetylene the writer, Henry Harrison Suplee, gives an account of some of the experiments made in liquefying the gas for commercial use. This method of using acetylene for lighting would seem to be unsafe in ordinary hands, but when the gas is made direct from the carbide with water it is as safe as any other gas. "It is probably no more poisonous,"

says Mr. Suplee, "than ordinary illuminating gas, while its characteristic odor causes leaks to be readily detected. A number of experiments by Vicille and Berthelot have demonstrated that at atmospheric pressures, a decomposition originated at any point is not propagated through the mass of the gas. Neither a spark, an explosion of fulminate, or direct contact with flame causes any action beyond the immediate vicinity of the heat. When, however, the gas is subjected to a greater pressure than two atmospheres, it exhibits all the properties of an explosive mixture; hence, the danger is clearly marked, mixtures of acetylene are,or are not explosive, according to the proportions of the two components, the limits being between three of gas to one of air, up to twenty of gas to one of air, this being a somewhat wider range than is found with ordinary illuminating gas." When the gas is better understood, the liquefied form may be safely used, as it would have great advantages, considering that the liquid is only one four-hundredth of the volume of the gas—that is, a foot of the liquid would make 400 feet of the gas. One remarkable thing about liquid acetylene is its expansibility. A given volume at a temperature of 32° F. becomes 1.07 volumes at 62°, and 1.24 volumes at 96° which shows it to be the most expansible liquid known. Cylinders should not be filled full, as when brought from a low to a high temperature it would rupture a very strong vessel. "In no case, however, should explosions of the liquefied gas be confounded with supposed dangers of the gas at ordinary pressure, as the two are absolutely distinct." In concluding his interesting article, Mr. Suplee says: "While it may be too soon to draw definite conclusions upon all the points at issue, we may infer that acetylene as an illuminant has a positive value, which for many purposes is immediately available; that it can be produced and used without greater risk or danger than is involved in the use of ordinary illuminating gas; that in the compressed or liquefied form it should be handled by experts under well ascertained conditions; but that notable advances must be made in its economical production if it is to compete broadly with coal and water gas as an illuminating agent." The writer here refers to the cost of manufacturing the carbide, which he puts at 2.02 horse-power per pound of carbide.

## BREAD VS. BOUQUETS.

Among the many attributes of perfection which are ascribed to the Ontario Government, that of Defender of the Beautiful has not hitherto been one. Culture its members have been known to possess, and a commendable interest has been shown in various cultures and cultivations from pigs to preachers, but their absolute devotion to the Beautiful has escaped public attention. The Parliament Buildings may be supposed to have had something to do with this; people who spent much time there could not but have their perceptions of the True and the Beautiful dulled, while it was generally conceded that any one who had anything to do with authorizing their erection must be entirely ignorant of the existence of these words, when spelled with capitals. But the public, as is generally the case, was wrong. The Ontario Government is prepared to sacrifice much to Beauty, and keeps the Niagara Peninsula a garden, a place of green grass and flower beds, and falling streams and trees; the resort of newly-married couples, and the people of Toronto on Saturday afternoons. The Government accepts $25,000 per year to keep in idleness a water-power whose development would be worth more to the Province than the timber limits about whose possible destruction we are at present so much agitated. We are well advised to look to our timber supply, of course; but if every stick of merchantable timber in Ontario were cut down, it could be replaced in time, though not without vast expenditure. But once permit the turning aside of natural and industrial forces, and who dare assume their return even with the most enormous expenditure? If the power of Niagara is once handed over to the citizens of the United States, it is lost to Canada forever.

In industry as in all living things there is no standing still; growth and death go on side by side and when growth is outrun by death the end comes. In the same way the industries of Ontario, and chiefly of Toronto and Hamilton, cannot go on in the next five years as they have in the past. Quebec has cheap labor to-day and to-morrow will have unlimited electrical power. We have only to name the great development companies over to remind ourselves of that: Chicoutimi, Montmorency, Shawenegan, Chambly, and Lachine. How can Ontario meet this competition except by power as cheap or cheaper than that in the neighboring province? If there were a tariff wall between the provinces, or if communication were slow and expensive, there might be some chance that the mill wheels of Ontario might still be turned by steam-power, but with the two best railways of the continent and the world's greatest waterway competing to reduce transportation charges there is no such chance. The only possible relief would be cheap coal, and Ontario has no coal, and southern Ontario has no power except what is derived from Niagara, and natural gas in a limited area of the West. Both of these are handed over to enrich aliens.

Some months ago in an article on this subject THE CANADIAN ENGINEER ventured the prediction that Niagara Falls would in future be more of an industrial force than an objective point for sightseers. We are pleased to notice that Lord Kelvin, during his recent visit to Niagara, at the time of the meeting of the British Association for the Advancement of Science, stated in an interview that he believed that all the waters of Lake Erie would ultimately find their way to Lake Ontario through electrical machinery. His Lordship said:

"I think we already see the beginning of what is destined to grow into a great industrial district around Niagara Falls, within ten or twenty miles of Niagara, both on the United States side and on the Canadian side. I do not prophesy anything, but I anticipate industry will advance on both sides of the border, and that the power of Niagara will be taken advantage of to any extent we may imagine. . . The originators of the work so far carried out and now in progress, hold concessions for the development of 450,000 horse-power from the Niagara River. I do not myself believe any such limit will bind the use of this great natural gift, and I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario, through machinery doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara. I wish I could think it possible that I could live to see this grand development."

We hope the silence which the Ontario Government preserves with regard to this subject is only a cover for the discretion which they are about to display in the development of the natural resources of the country. It is remarkable that a body of men, who display such admirable judgment in the management of their private affairs, and whose administration of the public domain should be in most cases so excellent as to defy criticism,

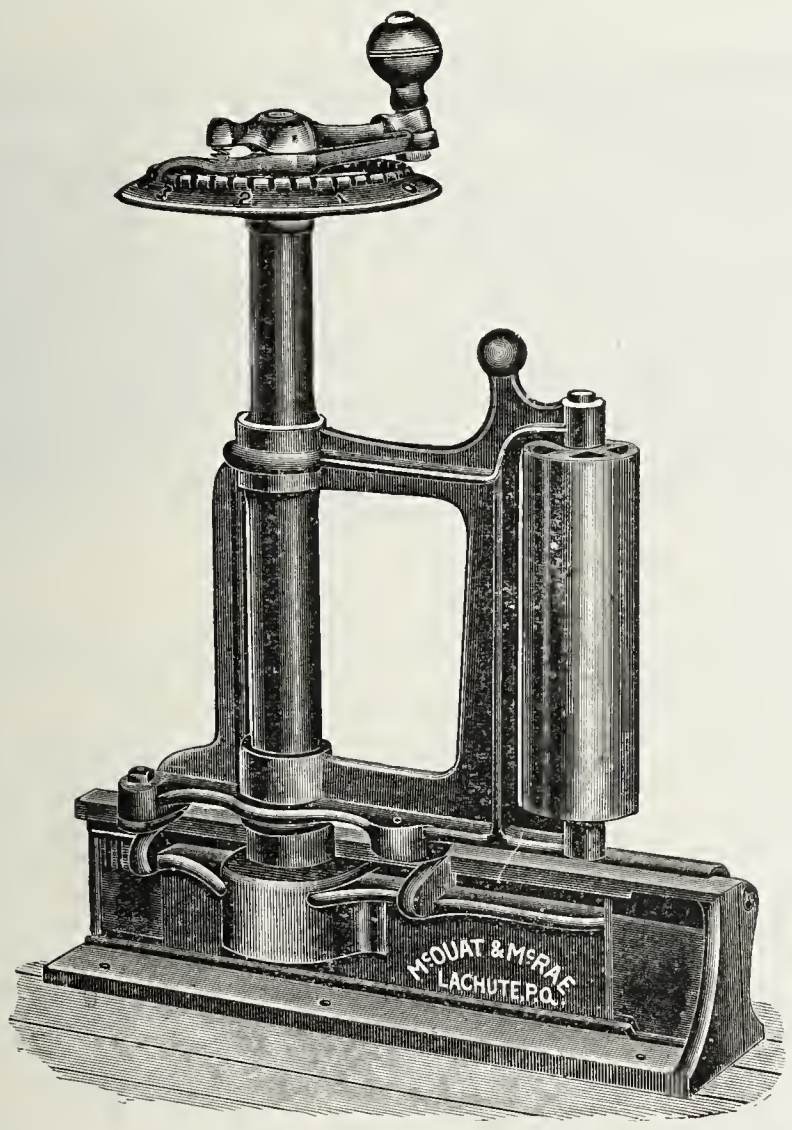
are unable apparently to make more out of one of our greatest assets than a few acres of flower garden.

Those who should be in a position to know state that the United States company has found means to arrest the proposed power development by a canal at Chippawa, and that nothing will come of the occasional activity of power company promoters on the Canadian side, at least nothing tending to the enrichment of Canadians generally.

What would be the verdict of the people upon a government which enacted a law forbidding the use of the steam engine and compelling manufacturers to resort to manual labor? What is the difference between forbidding the free use of steam in the past and forbidding the free use of electricity in southern Ontario for the next hundred years?

## TIMBER GAUGE.

The Climax timber gauge, invented and placed on the market by McOuat & McRae, Lachute, Que., has been a pronounced success and has made its way steadily among Canadian lumber manufacturers. The makers prove a number of advantages for this device, which is illustrated herewith:—

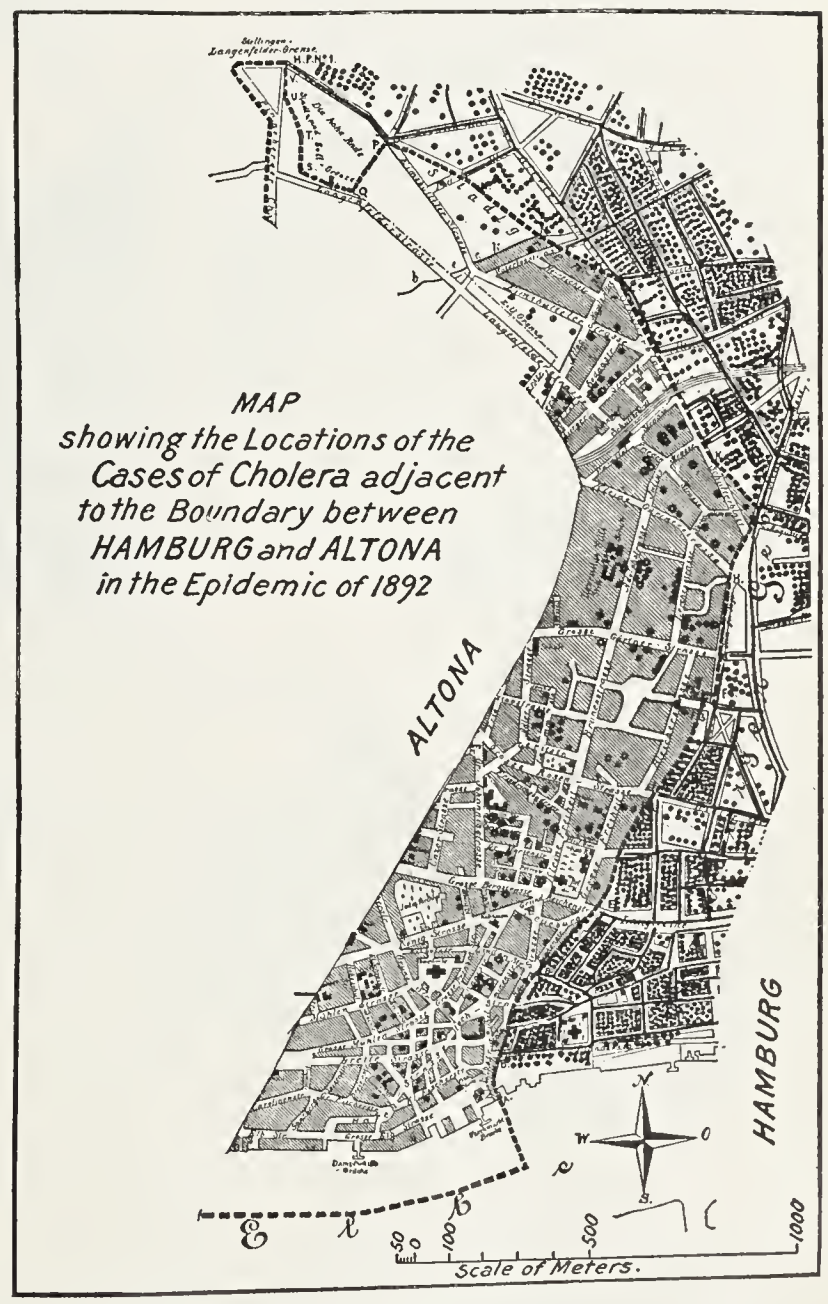



The roller arm swings over the bed, and is so arranged that if the log strikes it, through accident or carelessness, it is merely knocked out of place and can be replaced instantly, without injury. This alone is of great importance to the purchaser. The standard is not stationary, but moves back with the roller bracket. It is never nearer than 11 inches to the saw, and will move back 22 inches clear of the saw. It can be moved out still further without loosening a bolt. It can be changed in half a minute from a right hand machine to a left, by changing a small stopper from one side of the standard to the other. The dial plate is divided accurately into inches and quarter inches, with distinct figures cast on, and notches cut deeply to hold index hand, so that there is no possibility of slipping or shaking out of position. The roller can be changed for different sizes of lumber, by simply pressing down on the crank, and turning the required notch and letting it go, no pin being required. To cut lumber heavier or lighter than the exact size, it is not necessary to move the machine on the saw frame, as the index hand is provided with an adjustment for that purpose. In designing it the makers took care that no place was left where sawdust could lodge and clog the machine, and they guarantee it cannot clog. If after ten days trial it is not found satisfactory, the purchaser may return it at the expense of the manufacturers.

## FILTERED VS. UNFILTERED WATER.*

Through the researches of scientists it is to-day practicable to make hard water soft on a commercial scale; it is practicable to remove the matters giving rise to discoloration and disagreeable odors, and it is possible to remove almost to complete exclusion those minute forms of life which are supposed to be the source of many diseases, and which are carried and disseminated by water. In some cases natural influences effect a purification of water in certain directions; for instance, certain forms of low vegetable life in waters are destroyed by darkness; † certain other forms of microscopic life are destroyed by sunlight; ‡ certain impurities, like iron, can be removed by allowing the water to flow over a steep bed, or rapids, where it will become aerated. And a knowledge of these facts and many others, enables us to take any water that may be considered fit for a water supply to a city, and bring it to a very high standard of purity.

That pure water has been the means of saving many cities from dreadful consequences has had frequent proof. A recent very interesting case is that of the cities of Hamburg and Altona in Germany. The epidemic of cholera which broke out in Hamburg in 1892 will be remembered for its extremely "explosive" character. The history of this case is so very interesting that it will bear narration. On the river Elbe, some miles from the sea, there are two cities, adjoining and forming in appearance one city. These are Altona, a Prussian city,




Boundary line indicated by a line of dashes.
Cases of cholera by solid circles.
Cases of cholera imported from Hamburg by open circles.
Water mains in Hamburg streets by black lines.

and Hamburg, a free German city. A stranger walking through these cities would not know, unless informed, whether he was in Hamburg or in Altona. They are each supplied with water from the River Elbe, but their waterworks are independent of each other. In 1892 Altona took its water from the Elbe several miles below where the Hamburg sewers emptied into it. Hamburg took its water from above the city. At this point of the river the tidal influence is still felt, and at times the sewage from Hamburg is carried on a flood tide up the river occasionally as far as

*Abstracted from Some of the Important Water Supplies of Europe Considered Mainly from a Sanitary Standpoint, a paper by James H. Fuertes, Mem. Am. Soc. C.E., reprinted from the *Journal* of the Association of Civil Engineers of Cornell University.

†"Some Observations on the Relation of Light to the Growth of Diatoms," Geo. C. Whipple in a paper at the Ann. Conv. of the N. England W. Wks. Association, June 10, 1896.

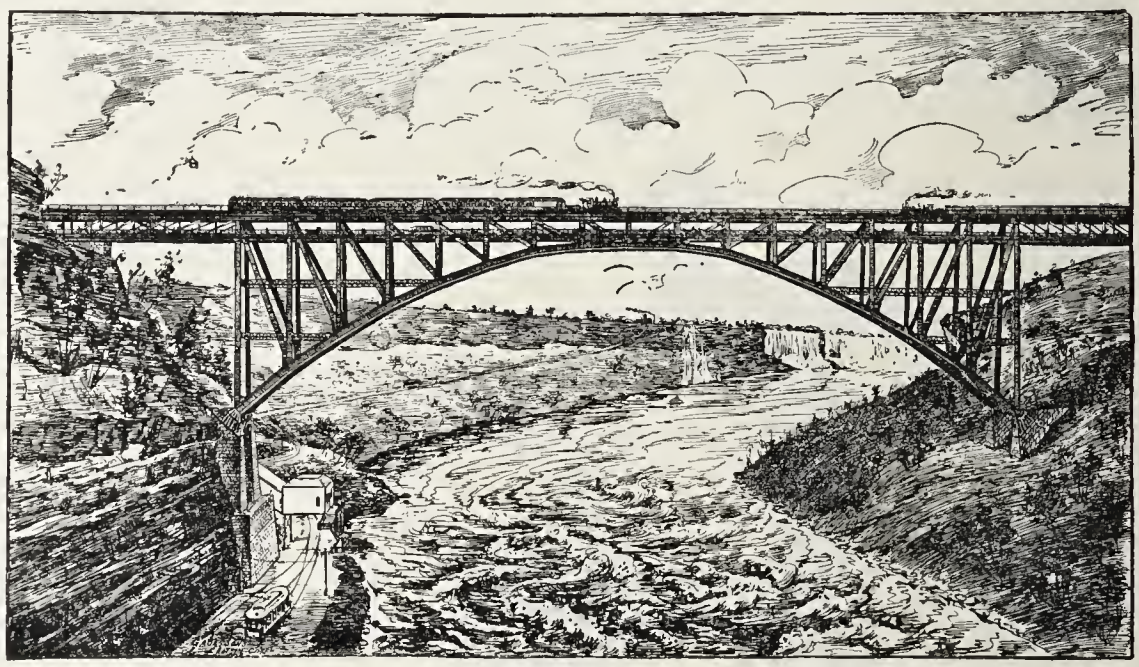
‡"Water Supply," Professor Mason, 1896, p. 66.

the water-works. The Altona water was all filtered through large sand filters, carefully operated, while the Hamburg water was supplied to the people just as it was taken from the river. On August 16th, the epidemic of cholera in Hamburg began to spread alarm. In 12 days the epidemic had reached its height, and during the week of its extreme severity there were more than 6,000 cases of cholera in Hamburg. In about 12 days more the worst was over. By an inspection of the map of that part of the two cities near the boundary line between them, it will be seen how comparatively few cases appeared in Altona, and that it is possible, with an approach to accuracy, to define this municipal line by the location of the deaths from cholera. Many of the cases in Altona were caused by drinking the Hamburg water; many were developed there from other modes of infection, and many cases were of doubtful origin; but the fact shows graphically enough that the Altona filters saved that city from the fate that made Hamburg lose 8,000 lives in about a month, and spread terror and apprehension over the whole world.

The improvements at once undertaken and carried out in the water supply of Hamburg, have placed the city on an equality with its neighbor in the matter of pure water. The tests which are made almost continuously show the water to be comparatively constant in its composition and of a very high degree of purity.

## THE NEW NIAGARA BRIDGE.

In our August number, we gave a description of the new great single-arch bridge of the G.T.R. over the Niagara, which replaces the well-known old suspension bridge. It only remains to say that the formal opening of the new structure took place last month beginning on the 23rd and lasting three days. Enormous crowds were present each day and night, and the fireworks display exceeded anything of the kind ever seen in Canada. A very elaborate programme of entertainment was provided for each afternoon on both sides of the river, and—what formed a very agreeable novelty in entertainments—all was free. The Grand Trunk Railway are to be congratulated on the handsome way in which they provided for the pleasure of the people, and upon their ability to provide for the transportation of such vast crowds of excursionists.



NEW NIAGARA BRIDGE.

## BAILLAIRGE'S MARINE REVOLVING STEAM EXPRESS.

*Editor* THE CANADIAN ENGINEER.

SIR,—Marine Revolving Steam Express is the name of a vessel conceived by the undersigned, now some forty or more years ago. How the idea struck him or was originated in his mind, was from observing the rotation of a wheel under the impetus given to it by the feet of a squirrel. He imagined that such a wheel, if inclosed all around, and partly up the outer periphery of the ends or sides towards the centre or axis, and if then laid to run on any smooth surface or ice, would thus move with great velocity by the constant displacement of its centre of gravity by the motor inside of it. The same effect would, of course, obtain on any liquid surface as that of water, in which case it might be advantageous to put paddles around the vessel or cylinder to guard against any tendency to its slipping, and consequent backward or less speedy forward motion, though upon trial such paddles might prove to be of no necessity.

The diagrams on the accompanying plate are merely intended to be suggestive of the mode of steering such a vessel, by a rudder attached to it in a way to allow the vessel to revolve without carrying the steering apparatus with it in its revolution; as for instance, by tying it by a chain or belt around the vessel in a groove in the keel, said groove set with a series of friction wheels to ease the motion, and the rudder itself made heavy enough, without any tendency to sink, or while buoyant enough to float, too heavy for the vessel to lift out of the water; the steering gear being as shown, fixed to an outrigger extending each side through the open ends of the vessel, and supported by the engine, or as well as the passengers and freight on, or from a platform attached to the engine, or forming portion of the construction thereof. The smokestack of the engine, if driven by steam; or of the generator, if by electricity or compressed air, would of course have to be also taken out at the ends or at one of them, unless by dividing the outlet it were found, while balancing weight on each side, to accommodate itself better to the direction of the wind, shutting off one side while opening the other, or by both sides simultaneously if found advisable.

Now this idea or mere element could be multiplied or extended as required, so that the vessel which as per design might be suited to a mere lake or river with no wind blowing of sufficient force to overturn it, or as a mere water bicycle, could be adapted to rough water, to hold more passengers and freight by extending the vessel or cylindrical hull in length, while the diameter remained the same, or extending both in any required ratio. The hull or cylinder, for instance, might be of length to accommodate two or more motors climbing up its side together, when the two or three or more might be joined by one passenger and freight-carrying platform pivoted in a manner to remain in a horizontal position, as has been proposed for the dining room or saloon of an ocean vessel, in a way not to rock or pitch with the vessel. Again, the outriggers protruding from the ends of the vessel might be so braced from the non-revolving platform as to give them strength enough to suspend therefrom, as a car from a balloon, a circular or other water-tight receptacle, boat or vessel for outside passengers wherefrom to enjoy the view and air and such that, with any rolling of the hull or cylinder, the buoyancy of the outrigged boats, hanging as if from davits, would on striking the water help to right it and return it to its normal position. The diagrams show no other light penetrating openings than the open ends of the vessel, which in rough weather it might be necessary to curtail or partly enclose; but it is of course evident that any number of windows or lights might be introduced all around the hull or cylindrical surface, precisely as in an ocean steamer, and of course it could also be easily lighted up at night, as the want of sufficient daylight could be supplemented by gas or electricity with equal facility.

This plan has remained rolled up, out of sight and out of mind since it was made so many years ago, and at the time considered in advance of the age, though at the New York "World's Fair," held at the same epoch—sometime, I believe, before the war of secession (1853, I believe)—and at which it was on exhibition, though it, of course, attracted the less attention on account of its coming from such an end-of-the-world sort of place as Quebec, another invention purporting, as the papers then said, to be of the same description, had been exhibited by some minister of the gospel of a mechanical turn of mind, showing how two persons, who have never met may be similarly impressed, as with Adams' and Leveries "After Neptune." And now I see, by a paragraph in a recent issue of the Quebec *Daily Telegraph*, that some other individual, one F. A. Knapp, of Prescott, Ont., has also been similarly taken hold of. This fact it is which has awakened me to the possibility of there being something in it after all, and that the time has come when the invention can be carried out, which I heartily leave to Mr. Knapp to do, without even hinting at the possibility or probability of his having ever heard of my priority of conception. Again, I say, two or more persons may at the same time or at intervals of years be imbued with the same ideas, as in the case of the first artesian well at Grenelle, in France, while many such had existed in China from time almost immemorial, and in the same manner as suspension bridges had been conceived as new in Europe, while centuries ago to be found in Asia.

Finally, if my idea of so many years ago was then before its time, as was also the "Great Eastern" when built by Brunel, and as the latter is now, or vessels almost as big as it, beginning to be utilized, so may my apparently impossible-of-realization conception of 1850 become a reality, and I wish Mr. Knapp all success in making it so.

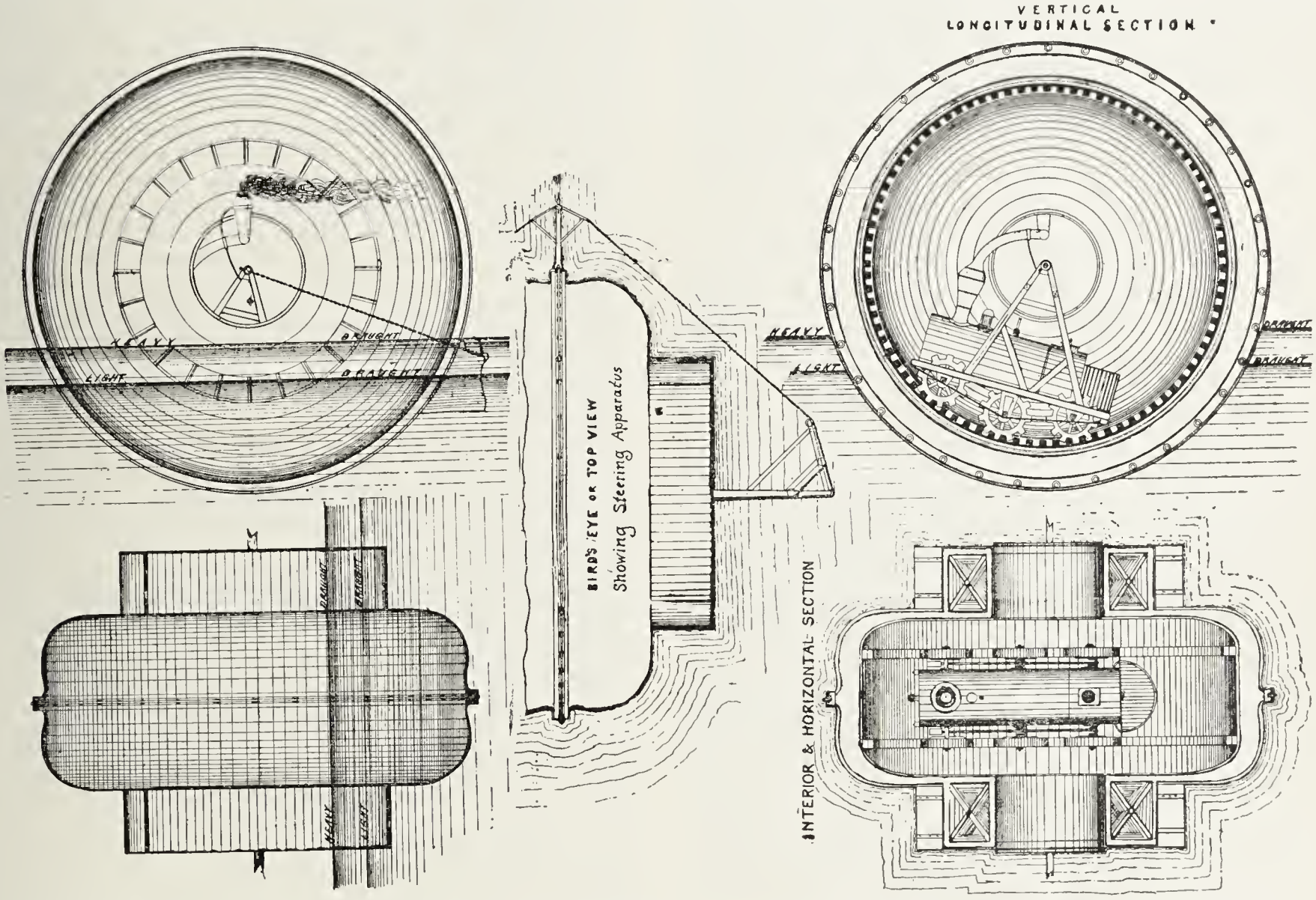
In this age of rapid transit the world is ready for something sensational of the kind, an advance on Martin's boat on wheels, while in this instance the wheel itself is the boat, and the boat revolves. Every one knows the piece of mechanism called a horse-power, where a horse

without any forward motion of his own causes an endless chain or wheel to revolve under his feet. Now, let the horse be placed within this endless wheel or chain, and made to tread its under inner surface instead of its outer upper periphery, and a correct idea will be formed of this rotating vessel; since the horse-impelled wheel would evidently advance, if not debarred from doing so by being made a fixture.

The idea is also illustrative of how such a wheel may be looked upon in the light of a revolving tramway, or railway track, or track for any other vehicle, or for any man or animal on foot, and by which said man, or animal, or vehicle or engine might be said to lay its or his own track as he or it advances, or to carry his or its track with it; thus smoothing or levelling the way itself in a manner to avoid rough or bad roads, or to avoid sinking into deep snow, or mud, or mire, or as a man on a bicycle might be supposed to do by running forward on or up the inner periphery of a wheel of larger diameter encircling him and his bicycle, and rotating and moving forward with him, and in a manner so to say, to lay his own track as he went along over soft or boggy ground or snow, into which his bicycle might otherwise have a tendency to sink and retard his motion, while also increasing his labor of pushing through. The lights necessary in such a vessel to satisfy the rules of navigation and prevent collisions and accidents by night, would of course be established at the extremities of the non-rotating outriggers. To these salient extremities of the non-rotating axis or shaft of the vessel, might also be attached circular signboards with the vessel's name painted thereon as on a medal, and arrangements could also easily be made by which a flagstaff might be erected at each end, and with halliards for working the colors as required.

Truly yours,

C. BAILLAIRGE.




## THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In the following paragraphs we attempt to give our readers an outline of some of the papers read before the British Association for the Advancement of Science at its Toronto meeting, which are of greatest technical interest.

### EARTHQUAKES.

Prof. John Milne, F.R.S., F.G.S., of Slode, Isle of Wight, delivered a lecture in the Massey Music Hall, Toronto, Aug. 23rd, on "Earthquakes," which was largely attended and very warmly received. Prof. Milne opened his address by referring to the fact that, because each student of engineering in Japan had to attend a course of twenty lectures on that particular branch of seismology, which has to deal with the subject of construction to resist the effects of earthquakes, it was evident that to satisfactorily epitomize all the knowledge we possess relating to seismology and volcanology within a period of 60 minutes, was a task of so much difficulty that, rather than speak of these subjects as a whole, he would practically confine himself to the answers of two very ordinary questions: First, what were the causes leading to displays of seismic and volcanic activity? And, secondly, what were the benefits we could expect to derive by studying the same?

In Japan, he told his audience that there was a belief, or, more correctly, a poetical conceit, that beneath the empire there lived a gigantic catfish, which, when it wagged its tail or moved its eyelids, shook the earth. Other subterranean monsters were the elephant of the Mussulman, the mole of India and the hog of the Celebes and Mongolia. After the shock, which, at the end of last year, rudely awakened the inhabitants of the Severn Valley, amongst other curious communications he received, there was one which at great length endeavored to prove that all the commotion was to be attributed to an earthquake-producing serpent which until recently had been buried beneath London, but which had escaped to the atmosphere and could from time to time be seen hovering above Trafalgar-square. Beneath Kamschatka the existence of a god called Tuil has been pictured, who drives with sleigh and dogs over subterranean snows, whilst beneath Scandinavia we have the imprisoned Loki, each of whom by his endeavors to escape or restlessness shakes our world. From subterranean mythology the lecturer passed on to the quasi-scientific theories of the middle ages, amongst which we find the unruly wind within the earth, which Shakespeare tells us "topples down steeples and moss-grown towers," the subterraneum tonitruum of Italy, the explosive gases and fatty vapors derived from a materia pinguis, chemical, electrical and other hypotheses.

The nineteenth century belief respecting earthquakes is that they are the result of rocky strata being bent—as in the process of mountain formation—beyond the limits of their elasticity. They are accelerations and announcements of orogenic and bradyseismical processes, which tell us that adjustments have taken place in the elastic or gravitational isostasy of the earth's crust. Wherever rocky masses are being folded, there we get earthquakes. If these foldings are near an ocean by capillary action water soaks inwards, a steam pressure is created, and the magma of molten rock and water from time to time finds an exit, and we get displays of volcanic activity. The reason that rock-folding exists is that the crust of our earth is not sufficiently strong to support itself above a nucleus which is gradually growing smaller by loss of heat. That which is happening on the surface of our earth is similar to that which would happen to an arch of brickwork of enormous span when the supporting centreing was withdrawn. Imagine such an arch supported on a centreing carried on piers across Lake Ontario, and then let the supports be gradually removed. The arch

would sink, crack, and buckle into ridges as it accommodated itself to the span between the piers. Each crack would represent a geological fault; when it was created the sudden snap would be an earthquake; whilst the hummucks and ridges would correspond to continental elevations and mountain ranges.

Turning to the useful aspect of seismology, Mr. Milne stated that, as the result of observation and experiment, many rules and formulæ had been arrived at respecting construction in earthquake countries, and it had been found that where these had been put into practice, the effect of seismic disturbances had been greatly mitigated. In Japan it was now clearly recognized that ordinary engineering practice as applied to embankments, piers for bridges, tall chimneys, the framing of ordinary dwellings, and other structures was to be avoided, and whenever, as, for example, after a disastrous earthquake, or a fire, reconstruction was required, new methods were adopted, the result of which is that the loss of life and property is being steadily reduced.

The application of seismometry to measure the irregular movements of locomotives has resulted in new forms of balancing the same.

The increased steadiness thus obtained is, among other things, accompanied by a marked saving in fuel. By the use of seismographs along the coast of Japan, submerged areas of seismic activity have been mapped through which it would be dangerous to lay a cable. Instruments which record the unfelt movements of the earth's crust sometimes tell us that cable interruption is due to earthquake action so far from land that it cannot be felt by those on shore. For want of information of this description in 1888, when three cables connecting Australia with Java were fractured simultaneously, in the former country naval and military reserves were called out, the supposition being that their sudden isolation indicated an operation of war. When it is remembered that this is by no means the only time a British colony has been suddenly cut off from communication with the rest of the world by the breaking of cables, such interruptions have shown the importance of being able to say whether this was brought about by natural or by artificial means cannot be overestimated. These same instruments, wherever they are established, give information of great seismic disturbances, even should they take place at the antipodes of the place of observation. Hence they enable us to correct, confirm, and even to disprove telegraphic information. From the enormous rate at which these earth messages pass through our earth, we see that our ideas respecting the effective rigidity of our planet must be modified. The daily tilting of horizontal pendulums has led to many experiments relating to the transpiration of plants and the subsurface condensation of moisture, which is of practical importance to the agriculturist. Possibly the long-continued tilting in one direction of these instruments may indicate that the ground or rock around that on which they are installed is gradually moving, seismic strain is increasing, and an earthquake may be expected. The seismograph has been employed to plot the roadbed of a railway, and in this way the condition of the whole line can be recorded and examined by the management at headquarters at any time.

Quite recently another line of investigation has been indicated which may possibly also lead to earthquake prediction. The effects of torsion and other stresses upon magnetized iron or nickel are well known, and it seems likely that the bending of rocks prior to the relief of stress may be accompanied by similar phenomena. In connection with this, Mr. Milne mentioned that prior to the two great earthquakes which last year devastated North Japan, at three magnetic observatories in that country the instruments showed unusual movements, commencing in both cases several days before the final collapse. The greatest magnetic perturbations took place some hours before the shocks, whilst afterwards, when seismic strain had been relieved, the magnetographs behaved in a normal manner.

The study of seismic sounds which are only heard on rocky strata, which do not travel far from their origin, which are not accompanied by perceptible movements, and which only occur from time to time, have been the means of laying many ghosts and re-establishing the reputation of country mansions. Severe shocks and volcanic outbursts have throughout the history of nations exerted an influence upon the nervous organization and the imagination, the effects of which may be seen in the character of a community, in literature, and its art. The study of earthquakes and volcanoes is of the greatest importance to the geologist, whilst it affords problems and facts of interest or value to the astronomer, the physicist, the mathematician, and to the student of all natural sciences; and in this way as an instrument increasing knowledge it becomes, directly or indirectly, a benefit to mankind.

Since his return to England, Prof. Milne has furnished a wonderful proof of the exactness of the records of the siesmograph. He writes: "While at the British Association meeting in Toronto I exhibited a seismogram which had been forwarded from my station on the Isle of Wight. This was the record of a large earthquake, the duration of which had been three hours. From the general character of the diagram, and because the preliminary tremors had a duration of 30 minutes, I suggested that the centre of the disturbance was in or near Japan, and, if so, originated there on Aug. 5, about 9.06 a.m. On Aug. 26, when I left Toronto, no news of such an earthquake had been received. I now find by mail advices, dated New York, Aug, 30, that in Japan there was an earthquake and tidal wave, accompanied by much loss of life, on Aug. 5 and 6. Capt Snow, of Yokohama, in a letter dated Aug. 5, says: 'While I am writing, a heavy, slow earthquake is going on. It is now 9 14 a.m.' The character of the motion felt by Snow indicates that Yokohama was a considerable distance, possibly 600 miles, from the place of origin of the disturbance. Therefore the time the earthquake took place was at least five minutes earlier than noted by Capt. Snow."

### CANADA'S METALS.

Prof. W. C. Roberts-Austen, C.B., F.R.S., director of the Royal Mint, London, delivered a lecture in the Massey Music Hall, Toronto, August 20th, which was of the greatest interest to Canadians, as well as to the visitors from the old world. Prof. Roberts-Austen began by remarking upon the distinct relation borne to the welfare of the Empire by the metals of Canada. The point of a great part of his remarks was in the evolution of this idea. The strength of every country depended largely upon its metals. He hoped the Mother Country would soon learn to turn towards her eldest daughter for a supply of those metals necessary to the defence of the Empire. Since the British Association met in Montreal in 1844 interest in Canadian metals had been renewed. The lecturer accredited this result largely to the efforts of the Canadian Geological Survey. The principal mineral products of Canada were in gold, silver, copper, nickel, lead and iron, as well as certain of the rarer metals. He told of the wealth in gold of the British Columbia, Ontario and Nova Scotia districts. The attention of the whole world had been attracted in a sudden and startling manner lately to the new region—the Klondike. People were dazzled by stories of a country where wealth was to be obtained at the expense of privation, and ofttimes of death. Since 1884 the annual mineral output of the Dominion had doubled. "There was now a very creditable and comprehensive collection of ore and metals at Ottawa, as well as at London. I hope before long," he added, amid appreciative applause, "to take home to my countrymen some facts that will make Canada better known to them."

The slow development of these resources, he went on, was due to many causes. The first was the conservative attitude of the Hudson Bay Company, who controlled the mineral regions, and who for many years had devoted themselves to other pursuits than mining. But Sir Donald Smith of that company had been the first to bring down specimens of Lake of the Woods and Rainy Lake ore, and there was no doubt as to its value. As an instance how the order of things had changed, he told how, when he visited Rat Portage in 1884, it was a town with 870 souls; it had now grown to have a population of 4,000. Another reason for slow development was the former lack of railway communication, and a third of the false idea as to climate.

"We Englishmen," said he, "are not so assured as to the real facts regarding your beautiful climate as we might be." Sir Wilfred Laurier had aptly described it as hot summers, cold winters, and dry always. As to the Ontario deposits, enough was known of the territory north of Lake Superior to satisfy one that it was possessed of mineral wealth which made it the most valuable part of the province. Apart from Ontario was the great gold country of the west, British Columbia, where, since 1881, there had been an output of $12,000,000 of gold. Of the Yukon, where millions would be extricated in a few years, he urged that a route from the south was greatly desirable. It was said that there was scarcely a creek in the region that did not contain gold.

Diverting, he warned those who read of the riches of the Klondike, that they should not forget the qualities of iron and steel. Iron was a necessity to the Empire, for the best guarantee of peace was a readiness at all times to defend the Empire. The Canadians at the Jubilee must have been impressed with the display of 400,000 tons of steel afloat at Spithead. It was a fact that the navy required one-half of the iron output of the Mother Land. "Need I longer plead for the production in Canada of iron and steel for the protection of the Empire?" This point was followed by a reproduction on canvas of a map of the Dominion and illustrations of the mining operations going on in its various parts. The lecturer followed out his plea for the navy by experimental evidence as to the exceptional qualities for armament purposes of an alloy composed of Canadian steel and nickel. This was an argument in favor of the idea of utilizing the Canadian baser metals for purposes of Imperial defence.

Then came the sensational display of the evening. Branching out from the topic of Canadian metals into that of the properties of metals in general, the lecturer, with the aid of an electric furnace, operated

by his assistant, Mr. Stansfield, threw upon the canvas a representation of the melting of various metals.

The experiments, which were then made for the first time on the continent, he explained as he concluded, were intended to teach that metals were not inert, but were vibrating masses of sensitive matter, strangely life-like. The forces of evolution in the inorganic were not less majestic than those now universally accepted as pertaining to the organic world. Many might shrink from advanced ideas of this sort, but if any present feared the process, he assured them, with Sir Thomas Brown, that we could not but have a conciousness of Divinity within.

MAKING FLUORINE GAS.

Fluorine gas was made for the first time in America, before the members of the chemistry section, by Prof. Meslans, assistant to Prof. Moissan, Paris, whose researches with fluorine have been one of the features of the recent chemical progress of the world. Prof. Meslans came to Canada to make the demonstration, and succeeded admirably. His running talk which accompanied the experiment was in French, and was merely a description of the apparatus and method employed. Prof. Meslans' apparatus consisted of a bucket filled with snow and salt, in which was immersed a "U" shaped tube containing hydrofluoric acid. Two electric wires dipped down into the liquid, and small copper tubes carried away the liberated gases. These tubes first ran into a curious little copper vessel which was filled with solidified carbonic acid and alcohol to keep the temperature sufficiently low to prevent the destruction of the apparatus. When Prof. Meslans had arranged everything to his satisfaction the current was turned on and the gas began to form. Then a number of experiments were carried on, showing that the curious element attacked practically everything presented to it, bursting into flame the moment it touched charcoal, silicon, alcohol, benzine, sulphur, potassium, iodide, and many other substances. The demonstrations were greeted with many bursts of applause.

THE CONDENSATION OF STEAM ON METAL SURFACES.

Before the Mechanical Science Section a paper was read by H. L. Callendar, M A., F.R.S., and by J. T. Nicholson, B.Sc., on new apparatus for studying the rate of condensation of steam on a metal surface at different temperatures and pressures. As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted, from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite, but finite and measurable. An account of these experiments was communicated to the Institute of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing year. In the meantime the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view to verify the results of their previous work, and also to estimate the probable effect of wetness or superheating of the steam, and the influence, if any, of the film of water adhering to the walls of the cylinder.

THE PRESENT TENDENCIES OF ELECTRIC TRAMWAY TRACTION.

The Mechanical Science Section heard a paper on "The Present Tendencies of Electric Tramway Traction," by J. G. Waldridge. Among other points the author said, tramway work is, at the present time, and has been for some years past, characterized by an increasing use of mechanical traction systems. The reasons for this are obvious and self-evident. It is, however, worth while to look into the considerations that, so far as electric traction is concerned, have caused one system or another to grow into favor, noting also the inherent qualities or attributes of each, which must have an effect on future developments. The United Kingdom has practically 130 miles of electric tramway at work or under construction; of this length 103½ miles are operated on the trolley or overhead wire system, 15¾ miles by means of a third rail conductor, 6 miles by means of storage batteries, and only four miles on the underground conduit system. Objections to the overhead trolley wire system are almost entirely aesthetic, but at the same time have such great weight and force that every incentive is offered to the genius of invention to make improvements in other directions. The ordinary underground conduit with open slot is most expensive to instal and troublesome to maintain efficiently, it cannot be built for less than £10,000 or £12,000 per mile. Closed conduits with surface contacts usually operated by means of electro-magnetic switching devices in boxes under the street level are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car; whilst the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed. The trolley seems to be the most desirable method.

NICOLA TESLA'S OSCILLATOR.

In the department of mathematical and physical science great interest was aroused by the reading of a paper prepared by Nicola Tesla on a new electrical oscillator, and the exhibition of the apparatus invented by him. The invention shown was a new machine for making Roentgen rays of extreme penetrating power. It is designed to take the place of an ordinary induction coil, for the purpose of exciting a Crookes' tube, and was said by Prof. Barker, of Philadelphia, who had seen it work in Tesla's laboratory, to furnish such a strong excitation, that with a fluoroscope he was enabled to look through Tesla himself, with the greatest ease. The device consisted of two large coils of wire mounted on a neat wooden base, which contained inside of it a new type of condenser made by Tesla himself. One of these coils acted as a magnet to make and break the current, and at the same time helped to charge the condenser. This latter in turn threw its electric power into the second coil, which acted like an ordinary induction coil, but with extraordinary efficiency. According to the scientists present, this scheme was an entirely new mode of using condensers. After the reading of the paper by Prof. McClennan, the room was darkened and the current turned on. With a current from an ordinary incandescent lamp, sparks were produced six inches long. Then two fine wires tied to glass rods were stretched out parallel from the terminals. Immediately a band of glowing phosphorescent light was formed between the two, diversified with frequent brilliant sparks. During the discussion which followed several diverse theories were advanced to account for the operation of the new invention.

THE BARREN LANDS OF CANADA.

In the Geography Section, a paper read by J. B. Tyrrell, M.A., B.Sc., Ottawa, on The Barren Lands of Canada, was of especial moment. He stated that the barren lands, or more properly the northern plains and prairies of Canada, cover an area of about 350,000 square miles between the Mackenzie River and Hudson Bay, extending from the coast line of the Arctic Ocean down to the general northern limit of the forest. On the west coast of Hudson Bay they reach southward to north latitude 59 degrees, and thence their southern boundary extends in a northwesterly direction, roughly at right angles to the magnetic meridian, to within a short distance of the mouth of the Mackenzie River, crossing the Kazan at Ennadai Lake, the Telzoa River at Boyd Lake, and keeping some distance back from the shore of Great Slave Lake. In general character the country is a vast undulating, stony plain, thinly covered with short grass, while rounded rocky hills rise here and there through the stony clay. It can be divided into two fairly distinct portions, viz., the Coastal Plain, which rose from beneath the ocean in post-glacial times, and the Interior Upland, with a somewhat more pronounced topography, just as it was left at the close of the Glacial epoch. The whole country slopes gently towards the north-east, and the three main streams which drain it have a more or less parallel course in that direction. These streams are the Back or Great Fish River, with a total length of 650 miles; the Telzoa, or Doobaunt River, with a length of 750 miles, and the Kazan River, with a length of about 490 miles. The author showed illustrations, drawn from photographs, exemplifying the general character of the country, its herds of reindeer, and its native inhabitants.

THE FUEL AND AIR SUPPLY OF THE EARTH.

Lord Kelvin read a paper before the Mathematical and Physical Section, on the "Fuel Supply and Air supply of the Earth." "All known fuel on the earth," began his lordship, "is the residue of ancient vegetation. One ton average fuel takes three tons oxygen to burn it; and therefore its vegetable origin, decomposing carbonic acid gas and water, by power of sunlight, give three tons oxygen to one atmosphere. Every square metre of earth's surface bears ten tons of air, of which two tons is oxygen. The whole surface is 124 thousand millions of acres, or 510,000,000,000,000 of square metres. Hence there is not more than 340,000,000,000,000 tons of fuel on the earth, and this is probably the exact amount; because probably all the oxygen in our atmosphere came from primeval vegetation. The surely available coal supply of England and Scotland was estimated by the Coal Supply Commission of 1831, which included Sir Roderick Murchison and Sir Andrew Ramsay among its members, as being 146 thousand million tons. This is approximately six-tenths of a ton per square metre of area of Great Britain. To burn it all would take one and eight-tenths of a ton of oxygen per square metre, or within two-tenths of a ton of the whole oxygen of the atmosphere resting on Great Britain. The commission estimated 56 thousand million tons more of coal, as probably existing at present in lower and less easily accessible strata.

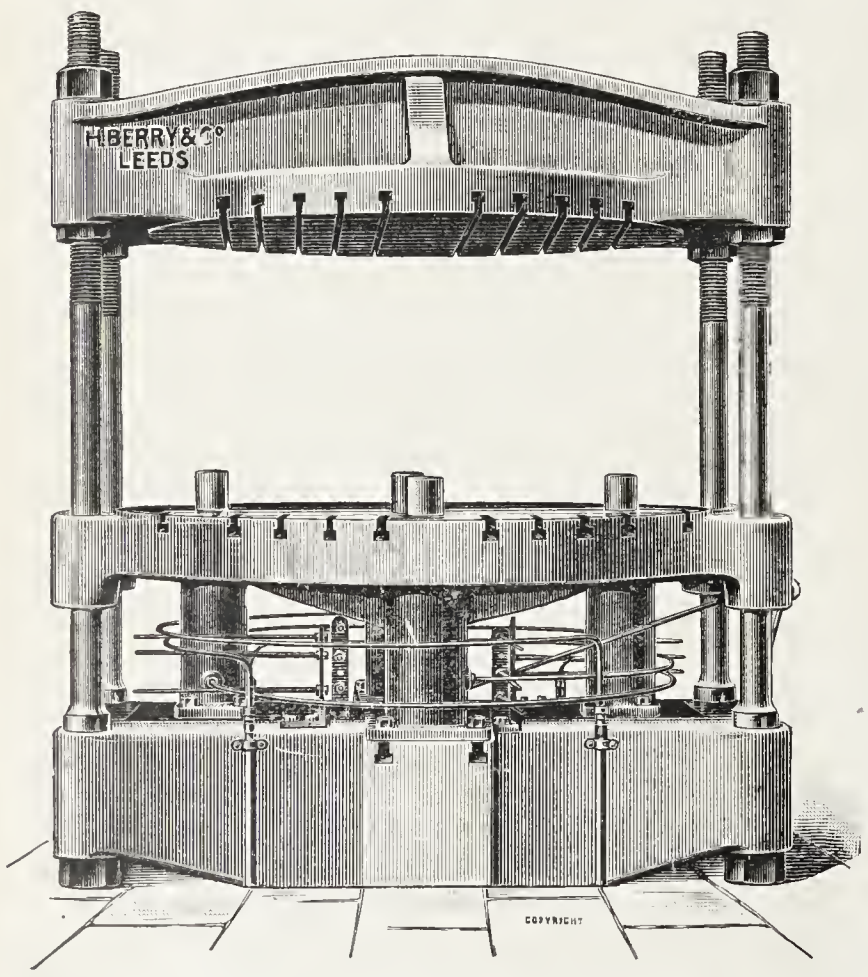
It may, therefore, be considered as almost quite certain that Great Britain could not burn all its own fuel with its own air, and, therefore, that the coal of Britain is considerably in excess of the fuel supply of the rest of the world, reckoned in equal areas, whether of land or sea."

In an Imperial Hydrographic Survey, read before the Mathematical and Physical section by Alexander Johnson, M.A., LL.D., professor of mathematics, McGill University, the author explained that in 1884, at the Montreal meeting of the Association, a paper was submitted to Section A by the present writer, in consequence of which a committee was appointed for the "promotion of tidal observations in Canada." The writer was made secretary, and subsequently chairman. This committee, supported by the Royal Society of Canada, and by those specially interested in navigation, succeeded, after many delays, in getting the Canadian Government, in 1890, to make a grant for tidal observations, which were to include not only the rise and fall of tide, but also the tidal currents. The grant was continued from that time until the present year, when it was reduced so that the survey of the currents could not be continued this summer, although an investigation of the utmost importance for the navigation of the St. Lawrence, more especially when the fast Atlantic line is going to be established. Possibly the entire grant is imperilled. It is believed that this reduction would probably not have taken place had there been in existence a fully organized hydrographic survey for Canada to advise the Government. The Royal Society of Canada had some time ago recommended the creation of such a department, and at its recent meeting in Halifax, appointed a deputation to present its views to the Government. The work of such a department can probably be most effectively carried out with the co-operation of the Admiralty.

The object of the communication was to seek the advice and aid of the British Association in inducing the Imperial and Canadian Governments to act together in making the necessary arrangements, which if found satisfactory, might possibly be extended to other colonies, and thus the basis of the Imperial Hydrographic Survey might be laid.

## HYDRAULIC FLANGING AND FORGING PRESS.

The accompanying engraving illustrates a special type of hydraulic flanging press manufactured by the firm of Henry Berry & Co., makers of special hydraulic machinery, Croyden Works, Hunslet, Leeds, England. This machine is invaluable in large locomotive works where the plates to be flanged are of irregular form. The press is fitted with four auxiliary rams for holding the plate to be flanged against the top die, and these can be adjusted radially. In addition to this the central main




HYDRAULIC FLANGING AND FORGING PRESS.

flanging ram is so arranged as to form a cylinder to receive a further vice ram which will hold the plates in position when too small to be dealt with by the outside vice rams. The regular standard types of these presses are made to admit plates from 7 feet to 9 feet, the diameter of the ram of the smallest size being 14 inches and the largest 17 inches, with a stroke in the former case of 28 inches and in the latter of 30 inches. This firm are extensive makers of almost every kind of hydraulic machinery for every purpose, and their catalogue is quite a cyclopedia of special machinery, some of which is made by no other firm.

## VIEW OF KING'S MOUNTAIN.

A very important work is being done by the Department of the Interior in mapping out the country which forms the boundary between Alaska and the Canadian Yukon. This work has been carried out

KING'S MOUNTAIN.

under W. F. King, chief astronomer, in honor of whom the mountain here shown has been called. It is a fine sample of Yukon scenery. The view is taken from near Pyramid Harbor, Chilcoot Inlet, looking south-westerly. The height of the peak is 6,500 feet.

## GAS FROM GARBAGE.

A representative of THE CANADIAN ENGINEER was called the other day to witness an interesting experiment in the production of illuminating gas from street garbage. For two or three years past, L. G. Harris, 55 Maitland street, Toronto, has been studying the problem of utilizing garbage, and as a result he has been able to show an experimental plant, in which a quality of gas about equal to that of Toronto can be generated at a cost of a few cents per thousand. The generator is a simple form of retort placed over a common box stove. Into this retort 10 or 12 lbs. of vegetable refuse, such as potato peelings, melon skins, etc., are thrown, after being mixed with two or three cups of gas oil and some chemicals—the latter being Mr. Harris' secret. A coke fire is started in the stove, and in a short time the contents are heated and the gas begins to develop in the retort. As it is evolved, it is passed through a cylinder filled with broken brick for drying it, and thence to a chamber filled with lime, by which it is purified. This is the whole process, as the gas then passes into the gas holder, whence it is distributed to the burners. The cost of the oil and chemicals for mixing with garbage to the extent of a ton, is estimated at from 50 cents to 75 cents, and a ton will produce 14,000 feet of gas. There is a residue left in the retorts in the form of a kind of coke, and it is calculated that enough of this coke will be produced in one charge to make fuel for the succeeding charge. If this calculation is borne out in actual experience, the cost of fuel will be entirely eliminated from the expense of operation. There is also a liquid residue, the nature and value of which has not been determined. As to the quality of the gas no analysis has yet been made, but Mr. Johnstone, inspector of gas for Toronto, and an official of the Consumers' Gas Co. regard it as being about 18 candle power, or two candle power above the standard; while the inventor claims that it is better than the gas of Toronto or any other city for cooking and heating purposes.

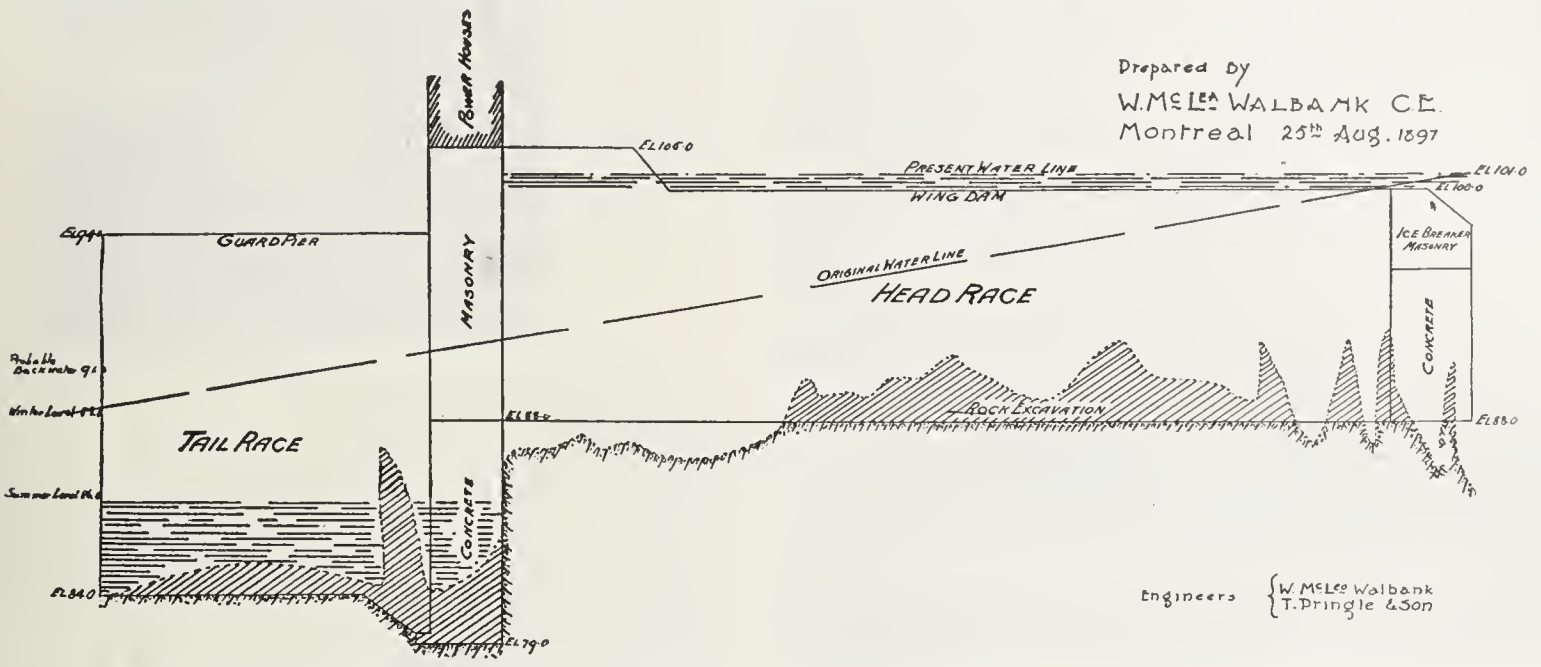
The cost of cremating the garbage in the two incinerators in Toronto is over $12,000 a year, and the cost of collecting and cremation together, apart from snow cleaning, amounts to about $50,000 a year. In many American cities of like population the cost of garbage disposal is considerably higher, the expense in Minneapolis, for instance, being $100,000 for removal alone, besides $20,000 paid to a contractor. The question of garbage disposal is a serious one for all cities, and if Mr. Harris can turn it into gas and coke as cheaply as he believes he can, a great advance will have been made in civic economy. At all events the mayor and medical health officer of Buffalo, along with a Buffalo capitalist, have been over to see his process, and so impressed are they with its utility that they seem likely to adopt it there, and have invited the authorities of Chicago and other cities of the States to investigate it. Peter Ryan and K. R. Arnett have acquired

the rights for Canada, and have a plant in daily operation at the corner of Church and Lombard streets, Toronto.

## LACHINE RAPIDS POWER.

On the 2nd August water was let into the dam of the Lachine Rapids Hydraulic and Land Co., the second largest electric power works in the world; and on the 25th September the formal opening of the works took place in the presence of a large number of visitors. On previous occasions THE CANADIAN ENGINEER has given descriptions of the hydraulic features, the electrical features and the structural features of these works. We give herewith a diagram indicating the physical features of the river bottom at the dam, and a reference to this in connection with our previous articles will show some of the problems that had to be solved in constructing the works. The observations of Messrs. Walbank and Pringle led them to believe that the difficulty of back water and ice in winter—which had been the *bete noir* of the engineers who had previously examined the Lachine Rapids—could be removed by blasting out the reef below the proposed site of the dam, and experience of last winter has shown that even the partial blasting away of this reef, which has already been accomplished, will do away with the trouble. There now only remains the question of the effect of frazil ice, but it is confidently believed that the large still-water basin above the works—walled off as it is by the boom and the natural dividing line of swift current at the head of the basin where the main body of water is deflected into the rapids at the rate of 10 to 20 feet per second—will avoid any serious trouble from this cause, as the still-water basin would be frozen over early, and frazil will not form under cover.

It may be of interest to recall the fact that the Lachine Rapids have been a source of power for over a century, one of the religious orders of Montreal owning a water power at the very site of the present works, where a grist mill, a flax mill, and a shop or foundry were running till the latter part of the present century. That this enormous power could be more extensively used evidently occurred to many, for in August, 1857, when the American Association for the Advancement of Science held its annual convention in Montreal a number of its members went down the rapids, and at the close of the meeting one of them congratulated the citizens on possessing such a city, and said there was "a power stored up here upon the shores, which within a hundred years will probably result in making this city the greatest city in America. This immense water-power being directed to the manufactures which might be established there, will make this one of the greatest cities of the globe." And yet this prediction was made before the possibilities of transforming water-power into electricity were realized. This prophecy probably moved local men to a consideration of the question, and in 1868 we find Thomas F. Miller writing a pamphlet on the subject, and recommending the very thing which the engineers of the present work have carried out, that is the formation of "a sort of lake or pond as the supplying source in which an unvarying head would be secured, over which ice would, of course, form rapidly as far as still water extended upwards, where all the frazil coming from beyond (none could form in this pond) would, with the current which brings it down—in consequence of the resistance here presented—be deflected and swept off into the rapids and main channel of the river south of Ile au Heron." It remained for the present company to carry out the theories then advanced, and the result is the largest power development in Canada. The company has spent $1,500,000, and has recently had its capital increased to $1,750,000, practically all being Canadian money. As before stated there are now 48 wheels installed, but room is provided for 72. There will then be 12 generators, each connected to a series of six wheels, and making 175 revolutions per minute and generating current at 4,400 volts. The current is carried to the city on cables supported on steel lattice poles, the first of the kind used in this country. In order not to interfere with canal navigation the cables are led under the canal near Wellington street by a subway [shown in course of construction in the accompanying cut], which was built in the short space of 14 days, while the water was let out of the canal for cleaning. The cables are thence carried to the sub-station at the intersection of McCord and Seminary streets, where it is distributed for the city. The company has a controlling interest in the Citizens Light and Power Company, which has a 50 years' franchise for supplying St. Henri and St. Cunegonde suburbs, and shorter contracts for street lighting in Westmount and St. Louis de Mile End. It has also a controlling interest in the Standard Light and Power Co., which by a decision of the Privy Council, given on the very day the water was



THE INTERIOR OF POWER HOUSE.

SUBWAY UNDER THE LACHINE CANAL.

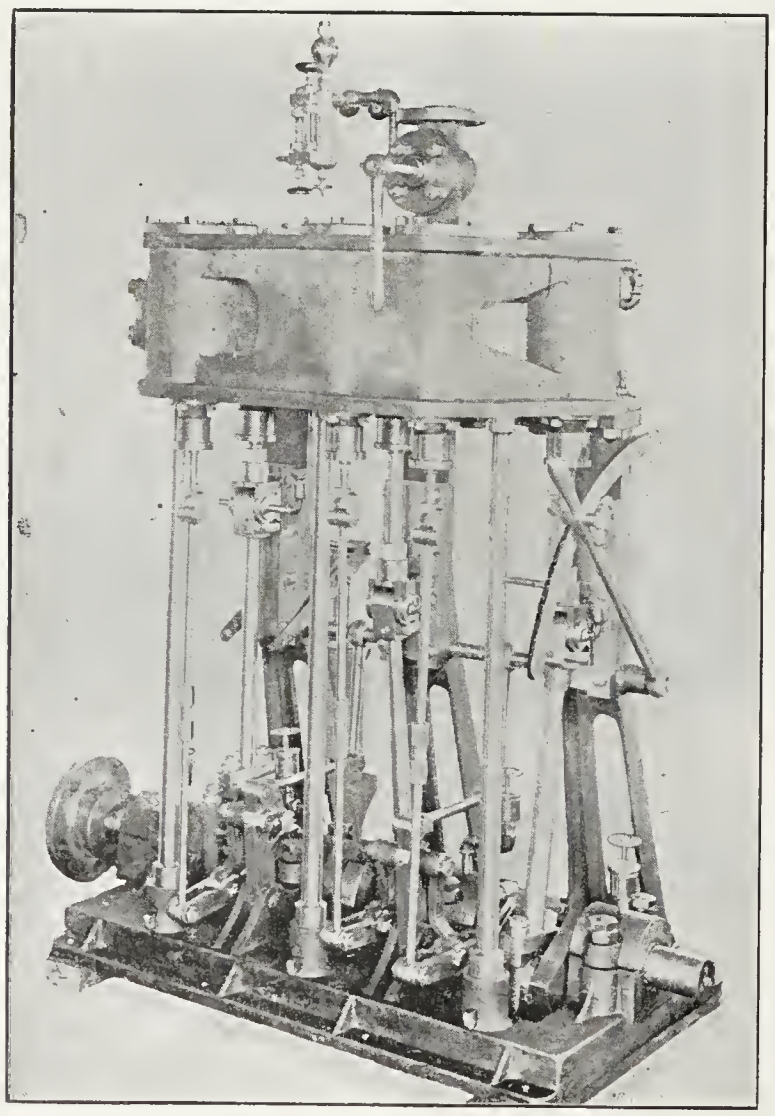
let into the dam, will have the power to construct electrical works in other cities, as well as in Montreal. The company owns a considerable amount of land near its Lachine works, and it is intended to lay out the foundations of a town and park, which will be connected by electric railway with Montreal. The officers of the company are: G. B. Burland, president; Alex. Fraser, vice-president; W. McLea Walbank, managing director, the other directors being R. Wilson Smith, S. Carsley, E. K. Greene, and Peter Lyall; Robert White, sec.-treas.; A. Cinq-Mars, auditor; T. Pringle & Son, mechanical engineers; R. S. Kelsch, operating superintendent; John Dodds, mech. superintendent; D. Barton, asst. electrical engineer; W. Kelsch, foreman of underground work, and E. Craig, superintendent of arc lighting.

## A LAKE BUILT YACHT.

The cut shown herewith is from a photo of a cabin steam yacht built by Davis & Sons, of Kingston, Ont., for W. L. Standish, of Pittsburg, Pa., and now running on Lake Muskoka. She is 52 feet long, 10 feet beam, 4½ feet deep, and draws 40 inches of water. This handsome boat was contracted for on the 10th April last, to be completed

LAKE BOAT YACHT.

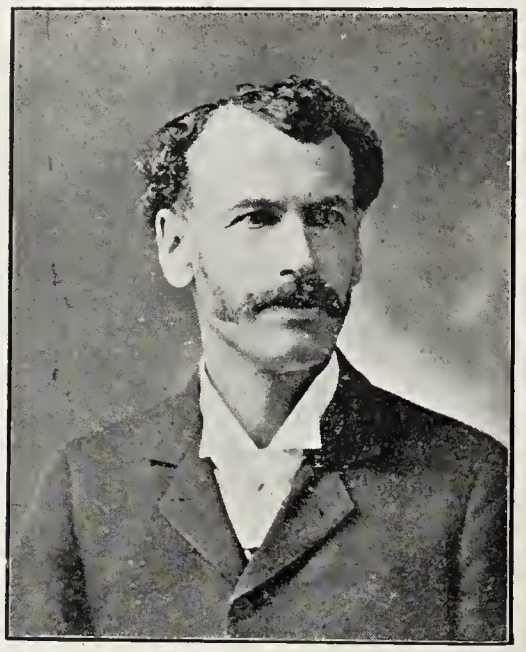
and loaded on cars by the 10th July. She made her trial run on the 8th July, with the owner and his wife, A. T. Lowe, engineer, and several gentlemen, and made a satisfactory record, and was shipped within the time called for in the contract. Her engines, which are shown in the cut herewith, are triple expansion, the size of cylinders being 5 inches, 8 inches and 13 inches, by 8-inch stroke, and capable of propelling the boat 13 miles an hour. These engines are fitted with the Bremme reversing gear, and turn a 38-inch brass wheel with 60-inch lead at a speed of 300 revolutions per minute when working under a pressure of 160 lbs. of steam. The boiler supplies 200 lbs. of steam



easily, and when the throttle is open the propeller will run up to 370 revolutions a minute. The engines and boiler were designed and made in Davis & Sons' own machine shops, and are considered a creditable piece of work.

## WM. B. MACKENZIE,

MEM. CAN. SOC. C.E., MEM. AM. INST. C.E.



W. B. Mackenzie, who has recently been promoted to the position of chief engineer of the Intercolonial Railway, is a native of Pictou county, N.S., and is the eldest son of the late James Mackenzie, a farmer, land surveyor and road-maker, who did a large part of the land surveying, and highway location and construction in Eastern Canada. Mr. Mackenzie followed his father in these different occupations from the time he became old enough to hold the rear end of the chain and keep "tally" by cutting notches on a stick. After studying mathematics, including land surveying and navigation under Prof. Bayne in the Pictou Academy, he, in 1870, became leveler on the first preliminary survey of the Eastern Extension Railway, between New Glasgow and Cape Breton, and was in the same year appointed crown land surveyor for the county of Halifax. In 1872, when the Intercolonial was opened between Truro and Amherst, he was made office assistant in the chief engineer's office at Moncton, during which time he studied railroad engineering after office hours, including graphic statics, commenced under the tuition of Prof. Greene, of Michigan University. This, together with the bridge engineering course of the International Correspondence School, and other engineering subjects, has fully occupied his leisure hours to the present time. In 1879 he was appointed assistant engineer of the I.C.R. In this capacity he located and built the several branches of the Intercolonial, and designed the greater part of the bridge and bridge renewal work on the I.C.R. and P. E. Island railways, under the direction of the chief engineer, P. S. Archibald. He has travelled over and examined the tracks and bridges of the principal railroads in the United States, and has been quite successful in collecting information for the defence of several important I.C.R. law cases. In 1895 he spent several weeks at the principal U. S. creosoting works, and made a special study of the process at Norfolk, Va., where 1,900 piles were creosoted for the I.C.R. He has writen several essays on engineering subjects, such as: "Notes on Railway Location and Construction in Eastern Canada" (Trans. N.S. Institute of Science); "Cribwork Retaining Walls" (THE CANADIAN ENGINEER, Apr., '96); "Creosoting Timber" (pamphlet); "Painting Metal Bridges" (pamphlet); "The Tidal Marshes of the Bay of Fundy" (pamphlet). The third has been highly spoken of by competent judges, and the fourth is pronounced by the *Engineering Magazine* to be "one of the best essays on the subject that has recently appeared." He has been a member of the Nova Scotia Institute of Science and of the Canadian and American Societies of Civil Engineers for many years. His frequent inspections of I.C.R. connecting and other lines of railway has afforded him valuable experience, which, with an intimate knowledge of the Intercolonial Railway, seems to point him out as a person especially fitted for his present position.

The annual report of the Association of Ontario Land Surveyors for 1897 has just been issued, and makes a volume of 182 pages. The report contains the full text of the papers read at the last annual meeting in February, with reports of the discussions thereon, and the contents are, perhaps, more interesting than those of any previous issue. A portrait of Hon. S. P. Hurd, Surveyor General of Upper Canada in 1830, is given as a frontispiece, and a biographical sketch of him, with a picture of his birthplace in Bermuda, is given in the appendix. The obituary record contains the names of six members who have died during the past year, namely, W. R. Burke, Richard Coad, Michael Deane, J. R Peddar, Clifford E. Thomson and C. J. Wheelock. The secretary of the association is A. J. Van Nostrand, of Speight & Van Nostrand, Yonge street Arcade, Toronto, from whom all information can be obtained.

## AN ENGLISH OPINION OF THE FAST ATLANTIC SERVICE.

The new contractors (says a correspondent of the *Marine Engineer*, London, England, when writing about the fast Atlantic service recently), Petersen, Tate & Company, have published their intentions in regard to the matter. It appears that the old terminal ports are not to be forsaken after all, in spite of the pleading of Sir Sandford Fleming in the pages of the *Queen's Quarterly*. The St. Lawrence and the Mersey are still to be the objectives. So far, good. But I am more than surprised to hear that the vessels which it is said are "to equal the 'Campania' in speed and comfort," are to be built of the turret type. This may be a most excellent type for cargo vessels—indeed it must be so, or such keen business men as those who direct the fortunes of Clan and Angier Lines would not be adopting it—but it does not look as though it were specially, or at all, adapted for passenger ships. It would be a thousand pities if a new departure were to be adopted in this regard which might imperil the popularity of the line with passengers, and so prejudice the link which we have so long desired to see forged to connect our little island with its great colonies in the west and south. But one cannot help having the greatest misgivings in regard to the whole business. Personally, I don't like the idea of the turret ships. I should rather hesitate in putting forward that opinion, where my judgment is opposed to that of practical men whom the British and Canadian Government unite to honor and confide in. But I am somewhat emboldened to differ when I see that along with the turret idea is one which all men may well make bold to call ridiculous. The fleet is to consist of four vessels of 10,000 tons each. Of these, two are to be at work, giving a fortnightly service, within two years. The others will follow and make the service weekly, twelve months later. In passing, it may be remarked that it will be interesting to see if these ships really approach the great Cunarders in speed. But a fifth vessel is to be provided. It is she which excites my distrust of the whole scheme and that apart from any other consideration. Lest I should appear to be stating the case in an unfair way I will quote from the *Shipping Gazette*, which certainly does not appear hostile to the contractors or their device. "Apart from the details in regard to the design of the steamers, the contractors have had to face a very tangible difficulty in combatting the fogs of the St. Lawrence. . . . Mr. Petersen set himself to solve this hitherto almost unsolvable problem, and hit upon the happy and thoroughly feasible plan of employing a fast little craft of the torpedo boat type, to act as pilot and danger signal to the ocean steamers. The little vessel is designed to travel down the river and meet the incoming steamer, and is to be fitted with a sound signalling apparatus and a powerful electric searchlight. . . . . She will meet the approaching steamer on her passage up-river, sounding her signals at intervals, and giving an extra signal in case of danger. Taking charge of the steamer she precedes her, and, acting as a pilot, enables the navigation of the waterway to be conducted at a comparatively high speed, but nevertheless with comparative safety." The paragraph I have briefly quoted is printed by my contemporary in large type and is from the pen of their Newcastle correspondent. It concludes with a statement of the "great appreciation" with which the Canadian Government has accepted this "excellent device." But I imagine the Canadian Government is composed of neither sailors nor pilots, whilst I also feel sure that the Newcastle correspondent of the *Shipping Gazette* who went to see the firm which is at the moment in such prominence was a most experienced journalist, and one who did not allow the light of his own knowledge to obscure the 'happy idea' upon which Mr. Petersen had hit. What does it all mean? I am sure Mr. Petersen is welcome to all the credit his labors may bring him, and I hope his 'happy device' may prove as valuable as he expects. If the torpedo boat can find the liner to guide her, she could also find her to put a pilot aboard of her. That is to say, the pioneer can have on board no guide, whom she might not be able to put aboard the guided. I suppose the big boats will draw 26 feet of water. A torpedo boat draws more like six feet. Her search light then will prove a mere will-o'-the-wisp, unless she maintains constant soundings based on the draught of the vessel she is piloting. Surely a liner with a big crew and lots of deck room is more suitable for all this sounding than a little craft. But let that pass. Let us even assume that the little vessel is instinct with knowledge that cannot be put aboard the big ship. What good will she be? Has Mr. Petersen ever heard of or seen a sea fog, either in the Gulf of St. Lawrence or in British waters? Does he not know from hearsay, at least, as some of us know from experience, that what sailors call a dense fog means an atmosphere so thick that the officer on the bridge cannot see the crow's nest, and that the most powerful light that ever was put into a lighthouse is obscured at a few yards' distance? The search light will be useless unless the torpedo boat runs the chance by her proximity to the liner's bows, either of being run down or of leading the liner into shallow water as she avoids a collision. I do not say that the St. Lawrence is so bad as Mr. Petersen makes out in the matter of fogs, but I do say that when fog is encountered, either in the St. Lawrence or elsewhere, so dense that a leading boat of light draught is required to pilot a mail steamer, it is quite time for the captain to stop his engines and drop his pick."

## BOILER SETTING.

*Editor* CANADIAN ENGINEER.

SIR,—I was very much pleased with your article in your August number on the heating power and value of the coal we engineers have to handle daily. You have given the calorific value of coal and constant heating power of carbon 14.652, and the constant heating power of hydrogen 62.100; these two together you call volatile matter, or hydro-carbons = 14.652 + 62.100 — 5,400 neutralizing effect of oxygen less heat formed by the formation of nitric acid. In the real value of coal, say anthracite or hard coal, we have the fixed carbon, which is contained now in the ashes we throw away, equal to 28.648. This is too much to throw away or lose, more than a quarter of a ton on a ton, and if what you say about the measurements by instruments is correct, we may safely say a great many men using coal do not get out more than one-half its value, by inattention and bad construction of furnaces and boilers. I have chosen anthracite, because I use more of it than of bituminous.

The question may be very naturally asked, how shall we get more heat out of our coal and ashes? Our attention must be turned to the construction of our boilers, furnaces and chimneys, and leave the instrumental measurements to decide afterwards. About thirty years ago, I got this subject before some of our manufacturers in this city; I then got a boiler 14 feet long by 48 inches diameter, with two large flues 11 inches diameter each, and above were 19 tubes 4 inches in diameter, with a division plate behind and a smoke box in front, with four strong cast brackets to carry the boiler over the fire; the brick bed was laid down; the front was what was called half front. There was a dead plate nine inches wide, with a recess for the ends of four feet bars, and a bearer at the back of the ash-pit. The bars were raised behind four inches; the brick work behind the bars sloped up to the end of the boiler to eight inches, and six inches short of the boiler. There was no bridge, for I saw it was not wanted. At first, when the fire and bars were put into the long flue of the old Cornish boiler, with bars fitted across the flue below the centre to give room above the bars; they also dipped the bars behind to give more room for the fire, and built up the back of the ash-pit so as to keep the ashes from getting beyond the reach of the fireman and also to prevent the air from going in farther than the fire bars. On the top of this wall they built the bridge to prevent the fire and coal from falling over the bars, so it is very apparent that a bridge was not to save coal or to sharpen the draught or to save the building of a proper or high chimney as is supposed by some of our engineers to-day. I have put together many furnaces within the past 60 years where the boiler was put on its bed, the front end was 20 inches from the dead-plate, and the back end was 8 inches from the brick or bridge, if you are pleased so to call it; the back end of boiler was one inch higher than the front end; the dome was straight up, and a centre line of the front end stood about the centre of the fire-door and ash-pit. I then divided the boiler end into three parts on each side of the centre line; two of these parts are enclosed in the fireplace with firebrick. At these points the firebricks were put on their edges, and the ends pushed against the sides of the boiler to stop the flame and smoke getting through. The wall here was set back 2½ inches, and was built up to the brackets on the boiler with pieces of boiler plate to move on when expanding. A thinner wall was built up above the top of the boiler to have bars put across, and on the top of those bars were plates of sheet iron, with bricks and mortar on top to keep in the heat, so that the boiler was enclosed as in an oven, with nothing touching it but the row on each side forming the fireplace. The reason why I divided the boiler end into six parts and took two into the fireplace was so that when the boiler expanded it would rise up and not push out on the brickwork, which can be renewed at any time from the inside, by taking out the bars and standing in the ash-pit. I built a large ash-pit, so that the air might be heated when entering the fire.

I have yet one of the boilers I set on this plan thirty years ago, and it is in good working order now, it has a good high chimney. I have others set on the same plan, but the chimneys are too low, so that I can only pass the heat through the boilers once.

I think if you could give us a good practical rule for building chimneys and setting boilers for every sort of coal, and then the instruments could be applied so that our ordinary engineers could see where their defects are, it would be of use to all enquirers.

I have a boiler set in on the same plan three years ago, 14 feet long, 48 inches in diameter, with 35 tubes 4 inch. Since that time, or I

may say, within the last two years, I have had seven new tubes put into it, each one taken out showing all over pits eaten into it. This boiler has to heat about 6,000 gallons of water per day for washing. What shall I put into it to prevent the tubes from being pitted and eaten away? I have another hot water boiler throwing off thousands of gallons every day which has done so for many years past and not a tube has been moved nor have any other repairs been made My impression is that the new inventions for smelting the iron and making the tubes and boiler sheets are not so good as the old Low Moor iron was. They call it steel to-day. I fear they are squeezing and rolling up a lot of scraps and putting a gloss on it and calling it steel. The sooner we get back to good iron the better, as it will save great expense and many dangerous accidents, and remove the blame from many poor dead engineers, who did their best with very bad boiler material. Both the hot water boilers of which I speak are supplied with city water and from a tank above. A large cylinder stands between the tank and boiler to receive the cold and hot water of each. After losing five tubes I was persuaded to feed this boiler from both ends, which I did, but do not find any advantage, for I have had to put in two tubes since.

Yours truly,

P. TROWERN,

Chief Engineer, Asylum for the Insane, Toronto.

## THE SARNIA GAS AND ELECTRIC LIGHT CO.

The electric light branch of the above company was established in 1894 and the plant was constructed during the summer of that year. The building, as will be seen by the accompanying illustration, is a handsome and substantial structure. It is built of red brick, with freestone trimmings and stone foundation, with basement under the engine and dynamo room, having truss roof, covered with iron, making the building practically fire-proof. Its dimensions are 34 x 72, with

POWER HOUSE.

octagon brick smoke-stack, 75 feet in height. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor. The electric plant consists of one 75-light, Wood arc dynamo, with spare armature; one 30-kilowatt T.H. single-phase alternator, with 1½ K.W. exciter, and necessary switchboard apparatus. All of the electrical plant was installed by the Canadian General Electric Co., of Toronto and Peterboro. The incandescent light business has developed to such an extent that it has been found necessary to increase the plant, consequently an order was recently placed with the Canadian General Electric Co. for another of their standard alternators of 60-kilowatt capacity. About 750 lights are now wired up and the number is rapidly increasing, which speaks highly for the efficient service given. The arc line for street lighting required over 16 miles of No. 6 B. & S. wire and 10 miles of poles. There are seventy 1,200 c.p. lamps in use. The steam plant consists of a Wheelock engine 13x30; two steel boilers, one 60 inches by 14 feet, and one 66 inches by 14 feet, both of the tubular type, with all necessary shafting and friction clutch pulleys manufactured by the Goldie & McCulloch Co., of Galt. In order to further increase the capacity and efficiency of the plant, a 300 h.p. Northey duplex condenser and duplex boiler feed pump were installed during the past summer, taking water supply from the river through an 8-inch pipe. These improvements add easily 25 per cent. to the economy and efficiency of the plant. Besides the addition of another dynamo and boiler, new steam and smoke connections have been put in.

AN Ontario charter has been issued to William Lindsay, Brisbane, Australia; J. Joyce and R. I. Bradley, Petrolia; J. Marshall, J. Wallen, Oil Springs, as the Intercolonal Deep-Well Boring and Manufacturing Company of Petrolia, Limited, to drill wells and manufacture and sell drills and drilling machinery.

## ACETYLENE GAS REGULATIONS.

The following is a copy of the restrictions imposed by the Canadian Fire Underwriters' Association, on the use of acetylene gas for illumination:—

1st.—That no calcium carbide or gas generating machine be allowed in any building insured.

2nd.—That generator must be placed in a separate building, constructed as follows, viz.:—Walls solid brick or stone not less than nine inches thick; roof entirely of iron or other fire-proof material; floor of cement or concrete with slight upward slope from door; entrance to be an iron or standard fire-proof door, no windows or other openings except for ventilation, which shall be through an iron pipe not less than six inches in diameter protected sufficiently through the roof and turned down at the outlet. Generators must be provided with escape pipes of sufficient capacity to allow gas to escape freely at a pressure not exceeding five inches of water. Care must be taken to deposit residue from generator at a safe distance from any building.

3rd.—That generator building must be located at least ten feet from a brick or stone building, or twenty feet from one of any other construction.

4th.—That the storage of calcium carbide be limited to three hundred pounds, to be kept in air-tight metallic cases not exceeding one hundred pounds capacity, and confined to the generator building.

5th.—That if the above regulations are not fully observed, double rates must be charged.

# Industrial Notes.

SPOONER had his "Copperine" at the exhibition again.

CHRIST CHURCH, Listowel, Ont., is now lighted by acetylene gas.

A NEW bridge is to be built over the Mississippi River, at Glen Isle, Ont.

A NEW provisional jail is to be built in Nelson, B.C., to cost $14,000.

A NEW railroad bridge is to be erected by the C.P.R., at Kemptville, Ont.

Two of the six miles of pipe are now laid in the Perth, Ont. waterworks.

THE village of Iroquois, Ont., is putting in an electric light plant and waterworks.

THE Farmer's Elevator Co., of Lumsden, N.W.T., will build a 30,000 bushel elevator.

THE Peterborough Bridge Co. is building a new iron swing bridge, at Rosedale, Victoria county, Ont.

THE ratepayers of St. Thomas, Ont., will vote on a by-law to raise $40,000 for building a new city hall, on the 11th inst.

THE Smith's Falls, Ont., school trustees are to spend $1,000 on a system of ventilating and heating the central school.

THE rebuilding of the eastern abattoir, Montreal, on its former position is opposed by the municipality of Delorimier.

PEUCHEN & CO, Toronto, acetic acid manufacturers, are rebuilding their Tonawanda, N.Y., branch, recently destroyed by fire.

THE cement works of the Rathbun Co. at Napanee Mills, Ont. are very busy, and two new kilns are being erected at the works.

THE Heinze Pickling Co., Pittsburg, Pa., is negotiating for premises to open a branch in Canada, probably in Hamilton, Ont.

AT the recent exhibition at Sydney, New South Wales, the Canada Paint Company of Montreal was awarded first prize for paints and varnishes.

DAVID WHITE, Brantford, Ont., is superintending the erection of a sawmill at Bell City, Rainy Lake, Ont. It will be running by November 1st.

J. H. Ross, formerly employed by the Goold Bicycle Works, Brantford, Ont., has been appointed a boiler inspector, with headquarters at Orillia.

THE Edwardsburg Starch Works, at Cardinal, Ont., are running day and night, and are to be enlarged so as to double the capacity of the works at once.

A BREAK in the Montreal water main, which passes under the Lachine Canal at Atwater avenue, recently gave the city water department considerable trouble to repair.

J. U. Ross, Hamilton, Ont., has bought the Haggart works, Brampton, Ont., which have been idle for some years, and will manufacture threshing machines, engines, etc.

ARCHITECT GAUTHIER, of Montreal, has been instructed to prepare plans for building an $18,000 addition to the Catholic Church of St. Thomas, of Alfred, Prescott county, Ont.

THE ratepayers of Gravenhurst, Ont., will vote in January on a by-law authorizing the expenditure of $16,000 on waterworks, $9,000 on an electric light plant, and $4,000 on a town hall.

WORK on the St. Lambert, Que., water and sewage works is being pushed by the contractors, Drummond, McCall & Co., Montreal, the legal difficulties raised by the opposing ratepayers having been overcome.

THE machinery at Toronto exhibition was lubricated with the Standard Oil Co 's "Capital Cylinder," "Renown Engine," and "Atlantic Red Oil" from the Queen City Oil Co., Limited, Toronto.

PAQUET & GODBOUT, St. Hyacinthe, Que , have been awarded the contract to build the new headmaster's house and gymnasium at Bishop's College School, Lennoxville, Que., and the plans have been prepared.

THE Hamilton Powder Company of Montreal has placed an order with the James Cooper Mfg. Co., Ltd., for an Ingersoll-Sergeant piston inlet compressor, to be used at its Beloeil works for pumping and agitating acids.

THE ratepayers of Springbank, N.W.T., are to vote on 14th inst. on a by-law to raise $40,000 on the security of their lands for the purpose of constructing a canal, laterals, flumes, reservoirs, etc., for the irrigation of the district.

THE Canada Paint Company has recently in one week booked orders for over one hundred tons of colors and varnishes. This is another example of the superiority of Canadian products when brought into direct competition with foreign goods.

THE Beacon Acetylene Generator Company, of Woodstock, Ont., lighted the Fair buildings at Woodstock, Ont., again this year with acetylene gas. Last year the results were very satisfactory, that being the first occasion when the new gas was used on a large scale in Ontario.

J. E. WHITTAKER & Co., St. John, are making rapid progress on their factory which is being built at Hampton, N.B. The main building, 100 by 40 feet, and the boiler house are nearing completion. Tinware will be manufactured, and an enamelling and graniteware department will be added shortly.

THE machine shop business of Jonathan Weir & Son, Moncton, N.B., which has recently been conducted under lease by the Record Foundry and Machine Co., will in future be managed by John P. Weir. The firm will undertake mill work, boiler making, forging and repairs of all kinds. Engines will be built to order, and a specialty will be made of locomotive repairs.

NEW sewers have been recommended for the following streets in Montreal: St. Denis, from St. Ignace to the C.P.R. track; De Montigny, from Beaudry to Montcalm streets; St. Henry, from Notre Dame to St. Paul streets; Desrivieres avenue, its whole length; St. Andre, from Marianna to Mount Royal avenue, and from Mount Royal avenue to Perrault street.

THE open season for most sorts of game is now on, but, of course, bonus hunting is always in. The Kingston *News* says in a recent issue: "The Wortman & Ward Manufacturing Company, of London, want a bonus of $12,000 and exemption from taxes to locate in this city. The board of trade will recommend the council to give them a free site and exemption from taxation without bonus."

DARBLAY, PERE & FILS, of Paris and Rouen, one of the largest pulp and paper-making firms in France, have had agents in New Brunswick recently making arrangements for a supply of spruce for pulp making. Export of pulp wood should not be encouraged, and if the large number of pulp mills now projected in New Brunswick are built, the supply for export will not be so great.

MANY of the St. John saw mills are shut down on account of the American tariff changes, says the Fredericton, N.B., *Reporter*. Stetson, Cutler & Co.'s large mill at Indiantown is silent, and a large number of men are idle. Jordan's mill, at Pleasant Point, is shut down; Miller & Woodman's two mills, at Milford, are closed, and Chas. Miller's mill is shut down. Murray's, Cushing's and the Grand Bay mills are still running.

CHIEF JUSTICE ARMOUR dismissed the suit brought recently in the Civil Assizes by Launcelot B. Montgomery against the Toronto Mineral Wool Company for $1,000 damages. Montgomery was moving an engine for the company, when one of the jacks supporting it gave out, and the engine fell over against Montgomery, inflicting injuries to his knee and abdomen. Montgomery held that the company was responsible, having supplied him with defective appliances. The court held that he was an expert, and should not have used the defective jack.

OVER 300 men are now employed in the C P.R. car shops, at Perth, Ont.

F. LEMOINE, Montreal, has been awarded the contract for the piers and abutments of the bridge at Edmonton, N.W.T., at $36,000.

THE Jesuit Fathers will shortly build a very large college building in Westmount, Montreal.

T. SMITH has the contract for the Perth, Ont., pumping station; building, to be completed by the 20th inst.

ST. HENRI, Que., recently voted $20,000 as a bonus to the Moseley Shoe Leather Company to establish a tannery.

IN Berlin, Ont., I. E. Shantz & Co.'s foundry, H. J. Hall's woodworking factory and the Berlin Brush Co. are working overtime.

THE Mooers Elevator Company, Kingston, Ont., has awarded the contract for the engine and boiler required for the elevator to the Goldie & McCulloch Co. of Galt, their tender being the lowest of seven.

SOME time ago a dam was built on the St. Francis River at Drummondville, Que., which developed about 10,000 horse-power. So far very little use has been made of the power, and the townspeople are disappointed.

HARVEY & Co., have their Newfoundland pulp mill ready for operation. It is expected that a number of other mills will shortly be erected if the first one proves a success, as it no doubt will, as Newfoundland has unlimited water-power and spruce wood.

THE Robb Engineering Co. have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric dynamos, and were ordered by an English Engineering firm for electric tramways at Barcelona and Madrid.

A. L. CURRY, of Curry Bros. & Bent, Bridgetown, N.S., is in Labrador in the interests of his firm. He is investigating the possibility of lumbering operations there on a large scale, for the purpose of shipping to Europe, and if his report is favorable, the firm will build mills there.—*Annapolis Spectator.*

RECENTLY while J. J. Copp, a moulder at the works of Rhodes, Curry & Co., Amherst, N.S., was carrying a ladle of hot iron from the furnace, he spilled a quantity of molten metal inside his boot. Before the boot could be removed the foot was terribly burned, the flesh from the instep to the great toe being destroyed.

THE Gravel and Construction Company, of Toronto, Limited, has been incorporated to construct public and private works, and deal in building and paving material, with a capital of $40,000. It is composed of A. Campbell, M.P., J. Smith and R. L. McCormack, Toronto Junction; J. P. McIntosh, Toronto, and A. H. Royce.

WALKERTON, ONT., has captured one of Toronto's important industries, the business of the American Rattan Co. having been purchased by the Walkerton parties, who will remove it to that town. The price paid for controlling the stock is $75,000, and about 100 hands are employed, many of whom will remove to Walkerton. The company was established in Toronto ten years ago with ten year's exemption.

THE contracts in connection with the new sewage interception works at Hamilton, Ont., were awarded as follows: Carpenter work, R. & J. Poag, $1,639; masonry excavation, etc., G. F. Webb, $5,699; machinery, A. J. Nie, $5,480; plumbing and steam heating, Fairley & Stewart, $633; roofing, J. E. Riddell, $897; painting, D. Kemp, $198; boilers, R. Quinn, $1,050; elevator, Leitch & Turnbull, $475; electric wiring, $130.

AT Brantford, Ont., the Paterson Biscuit Company is working 24 hours a day, new machinery will be installed; the Verity Plough Works are working day and night, and contemplate making large additions to the works; the Massey-Harris Company which generally closes down altogether in September, is now running full time; the Cockshutt Plow Company recently built an addition larger than the original factory, and will shortly close down a few days to instal a new boiler plant.

R. A. LATIMER. Montreal, carriage manufacturer's agent, has assigned at the demand of White, Chelloran & Buchanan; liabilities about $85,000. The principal creditors are: Canadian Carriage Co., Brockville, $13,073.13; Cossit Bros. Co., Brockville, $10,326.28; Brantford Carriage Co., $5,668.23; Wm. Gray & Co., Chatham, $4,287.79; G. M. Cossit & Bros., $3,934.57; Deering Harvester Co., Chicago, $3,541.94; McLaughlin Carriage Co., Oshawa, $2,300.82; J. W. Morin Mfg. Co., $2,852.50; Wortman & Ward Mfg. Co., London, $2,402.79; Wilkinson Plow Co., Toronto, $2,194.06; Chatham Mfg. Co., $1,807.42; P. T. Leger, Quebec, $1,000; Molsons Bank (securities), $10,878; Molsons Bank (mortgage), $3,802.73; Bishop's College, Lennoxville (privileges), $3,000.

ONE thousand shares have been subscribed in Shawville, Que., to sink a public artesian well.

THE Rathbun Company, Deseronto, Ont., has an order for 200,000 square feet of timber for the new railway bridge at Cornwall.

THE Toronto Paving Brick Co., Limited, has been incorporated, capital $190,000. The provisional directors are: A. E. Ames, J. Kilgour, A. A. McMichael, Wm. Crawford and J. B. Noble.

AN Ontario charter of incorporation has been granted to D. B. Wallace, Simcoe, Ont.; C. M. Richardson, G. Deighton, J. Flynn, and F. W. Hodson, Toronto, as the Winnipeg Heater Company of Toronto, Limited; capital, $24,000.

AN Ontario charter has been granted to H. C. Hunter, J. D. Wilson, J. J. Scott, Wm. Lees, and T. Hobson, Hamilton, as the Canister Machine Co., Limited, to carry on a packing business and manufacture cans and canisters, etc.

THE property of the Guelph, Ont., Norway Iron and Steel Co., Limited, failed to sell at auction on October 6th. It comprises a complete rolling mill plant, and about 80 tons of rails, boiler plates, etc. Jas. Naismith, Guelph, is liquidator of the company.

NOTICE is given by the Ontario Government that all companies not incorporated must before November 1, 1897, send to the Provincial Secretary returns of particulars relating to their work. Failure to comply with this means a fine of $20 a day, which will be levied, not only upon the company, but upon all directors, managers, secretaries, agents, travellers and salesmen, who with notice of such default transact in Ontario any business whatever for such company.

LORD MOUNT ROYAL wrote recently to the Minister of Trade and Commerce to lay before the Canadian lumbermen an opening for their product in London. He stated that almost the entire metropolis is paved with wooden blocks covered with a coating of asphalt. The blocks are described as "yellow deal," and are imported from Norway and Sweden. A single block of the yellow deal accompanied the High Commissioner's letter. If any Canadian firm were to undertake the experiment, the Canadian article could be tried in London, and possibly a very large trade worked up.

AT the meeting of the British Medical Association in Montreal recently, the question of sewage disposal was opened for discussion by a paper written by George Janin, C.E., formerly of the Corps de Ponts et Chaussees of France, and now of Montreal. The title of the paper was, "On the different processes recommended for the treatment of sewage—mechanical, chemical and epuration by the arable soil." In a concise manner the paper described the various attempts which had been made in other countries to purify sewage, with the indifferent results attending the same. This led up to purification through filtration or irrigation of permeable soil—a system of which Mr. Janin is an enthusiastic exponent. It was pointed out that enormous profits had been made from land on which sewage was poured in Germany and France Dr. Bryce, of Toronto, pointed out the success of the system at the London, Ont., Asylum, even in the coldest weather.

# Mining Matters.

THE people of Shawville, Que., will sink a well in search of natural gas or petroleum.

THE Jenckes Machine Co., of Sherbrooke, Que., shipped last week a complete tramway plant to the Lucky Jim mines, at Sandon, B.C.

THE Foley Mines, Seine River, Ont., are now installing two 100 h.-p. steel boilers, built by the Jenckes Machine Co., of Sherbrooke, Quebec.

A REPORTER for a Quebec paper, on a recent visit to Jersey Mills, Beauce county, Que., washed a pan of dirt which gave 21 dwts. 9 grs. of gold.

AN extensive find of copper and silver-bearing ore is reported from Pugwash, N.S., on Canfield Creek. Wm. Murray is the lucky prospector.

THE boring for oil at Pelican Rapids, Arthabasca Landing, N.W.T., has been suspended after the shaft had been sunk 800 feet, the pipe having become choked with tar.

WM. MILES, who recently staked a gold claim in the streets of Victoria, B.C., opposite the post office, is meeting with a great deal of opposition in his attempts to work the lead.

THE 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the entire complete plant with which Mr. Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

AT Tache station, on the C.P.R., 135 miles west of Port Arthur, alluvial gold is reported. The finds are said to reach at least five cents to the pan.

SPECIMENS from Gainer Creek, near Ferguson in the Lardeau district, British Columbia, were recently assayed at Kaslo Sampling Works, and were found to be enormously rich in gold.

THE Brookfield Mining Co., of North Brookfield, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a five-drill Ingersoll-Sergeant compressor, receiver, drills, etc.

THE Crow's Nest Mine, Melrose, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a duplex cross compound Ingersoll-Sergeant compressor, drills, receiver, etc.

THE Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, Que., which has been supplied from their Rossland stock.

THE statement that the Bannockburn Mining Company had taken over a large number of other mineral properties in Hastings county is unfounded. The company did take an option on several properties, but the arrangement has fallen through.

PROF. MILLER, of the Kingston School of Mining, was at Brudenell, Renfrew county, Ont., recently, assaying some mineral specimens which were brought in from the surrounding country. Large deposits of corundum have been found in this vicinity.

F. BLANCHARD, A. Barclay, R. and D. Mosher, Fort Frances, recently sold mining locations H. W. 54 and 87 to the Neepawa Gold Mining Co. for $16,000 cash. The property, which is situated in the Manitou district, near Blanchard Lake, is said to be very rich.

THE Hay Island Mining Co., Rat Portage, Ont., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rat Portage branch office, for a complete mining outfit, consisting of Ingersoll-Sergeant compressor, rock drills, hoisting engine, etc.

THE Old Ironsides Mine, at Greenwood, B.C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

THE agents of the Bank of Montreal in New York received last month from the Cariboo, B.C., Hydraulic Mining Companies a cone of gold worth $61,987 and weighing 3,606 ounces. This is the second shipment from the company's mines this summer, the first having been a clean-up of $70,921 in July.

THE Cariboo, B.C., Gold Fields, which own ground for one and three-quarter miles of the bed of Williams Creek, has at present about one hundred men at work constructing a ditch, so that when completed this company will have about fourteen miles of ditches, with a capacity of 2,000 inches of water. The ditch is nine feet wide at the top, four feet at the bottom, and two and one-half deep, with a grade of 9.60 to the mile.

THE Hall Mines, Limited, Nelson, B.C., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rossland, B.C., branch, an order for another ten-drill Ingersoll-Sergeant compressor, and five more Sergeant drills. This is the third compressor plant that the Hall Mines Co. has ordered from this company, and when it is installed the machinery at the Silver King mine will have a capacity of twenty-five drills.

THE news of the new coal discovery in the Codroy valley, Newfoundland, is confirmed. The seam is over six feet wide, and the quality is reported to be equal to the best North Sydney. It is also stated that the Messrs. Reid, the railway contractors, on whose land concessions the seam is found, will commence working it at an early date. It is altogether probable that in these extensive Codroy valleys more seams will be found. The Hon. H. J. B. Woods says 60,000 tons are in sight.

DR. WOLFORD NELSON, F.R.G.S., New York, who was in Montreal for the meeting of the British Medical Association, visited the Calumet mines on the Ottawa River, opposite Bryson, Que. In referring to the Meyer mine on Calumet Island, Dr. Nelson stated that Charles L. Meyer, of New York, had associated with him E. P. Cowes, an American miner of large experience, and Leopold Meyer, of Madrid. This Meyer mine, he said, yielded a rich argentiferous galena, carrying a small percentage of gold. The Russell mine, near the Meyer property, furnished a zinc blend, which carried 13 to 15 ounces of silver per ton. From the 45-foot level of that mine a good ore was being obtained, and it was bagged and shipped to Swansea, in Wales. The general outlook at Calumet, Dr. Nelson remarked, summing up the result of his visit in a few words, was exceedingly promising.

WM. KIRBY, Callendar, Ont., reports a find assaying $18 per ton in gold at that place.

SOME exceedingly rich finds of free gold are reported from around Lytton, B.C.

THE boring for oil at Fredericksburg, Ont., has been abandoned at a depth of 550 feet.

THE Harvey Hill copper mine, Megantic county, Que., has been closed, owing to the new duty.

THE coal mines at Lethbridge, N.W.T., will produce 12,000 tons per month during the winter.

VERY rich finds of placer gold are reported from the north fork of the McMillan River, another tributary of the Yukon.

AT the Dalhousie gold mine, near Lanark, Ont., the shaft is now sunk to the depth of forty feet and gives good indications of gold.

J. M. DOUGLAS, M.P., for East Assiniboia, reports at Winnipeg the discovery of a seam of what is claimed to be anthracite coal, on the Qu'Appelle River, near Wapella.

Now that there is some question of the iron ore deposits of the Bilbae district of Spain giving out, or becoming leaner, it might be advisable for our ironmasters to investigate the iron ores of Newfoundland. According to Dr. Grenfell there are immense—even unlimited—quantities of hematite ores of excellent quality at Bell Island, magnetic iron and pyrites in many places, and chrome-iron ore in abundance at Port-a-Port. There are also deposits of nickel ores, asbestos, copper, coal, etc., in many parts of this our oldest and nearest colony. We ought not to let these minerals drift into the hands of American firms.—*The Ironmonger, London.*

REPORTS to THE CANADIAN ENGINEER from the Wabigoon district show that mining business is rather dull there at present. As investigation proceeds it becomes evident that there are some promising properties there, but a good deal of money needs to be spent before the extent of value of the claims can be determined. One difficulty is that a number of the claims are in the hands of men whose capital is too small to develop them, and another is that speculators are holding their claims at figures that are altogether too high, when it is considered that many of the properties will prove on development to be non-paying.

GREAT progress is being made at the Foley mine, Rat Portage, Ont. A contract has been let to the Canadian Rand Drill Company, Montreal, for what will be the largest mining plant in the Rat Portage district. The compressor has compound steam cylinders operated in conjunction with a condensor. Air is to be conducted all over the different workings, so that when completed, operations may be carried on all over the property by means of compressed air as a power. As these workings are scattered, the change will do away with the use of several small boilers and effect a very considerable saving in the fuel bill and the pay roll.

How little is done for the country by even a mine whose ore is hlghly refractory, is shown by the following picture of the advantages accruing to Rossland, B.C., from the Le Roi mine: "The $50,000 paid as dividends every month to the stockholders of that mine do not reach Rossland, at least not much of it. It is paid in Spokane, mostly to Spokane people. All the miners are compelled to board at the company's boarding-house, and all the supplies for that boarding-house are purchased in Spokane. Many of the men have wives and families in the States, and the greater portion of their wages is sent to their families, so that Rossland derives very little benefit from its biggest mine."

DURING the past month the James Cooper Manufacturing Co., Limited, of Montreal, has supplied the following mining plants:—Canadian Goldfields Syndicate, Rossland, B.C., for Sunset Mine, a 7-drill Ingersoll-Sergeant compressor with full complement of Sergeant drills, boiler, hoisting and pumping plant; Ruth Mines, Sandon, B.C., a 5-drill Ingersoll-Sergeant compressor, necessary complement of Sergeant drills, boiler, and all accessories; G. Alexander, Kaslo, B.C., for Northern Bell and Jackson Mines, a 3-drill compressor, full complement of drills, etc.; Burley Gold Mining Co., Rat Portage, Ont., Ingersoll-Sergeant compressor, Sergeant drills, double compartment shaft hoisting engine, etc.; Guffey-Jennings Mining Co., Cariboo, N.S., an Ingersoll-Sergeant five drill air compressor, drills, etc.

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SPEAKING of the enormous electrical power in the neighborhood of Cornwall, Ont., a contemporary says: "With 1,000,000 horse-power at Massena and almost unlimited power on this river, furnished by the Cornwall Canal through the Sheik's Island reservoir, an international bridge and railways running north and south and east and west, on both sides of the river, this section of country offers unsurpassed advantages for manufacturing industries and general commerce."

# Electric Flashes.

THE Royal Electric Co. is doing the lighting of the Montreal Post Office building.

THE long-distance telephone between Ottawa and Boston is now complete.

AT Vernon, B C., a by-law to raise $12,000 for an electric light plant has been carried by the ratepayers.

GEO. WILSON town clerk, Glencoe, Ont., calls for tenders for the electric street lighting of the town for a term of five years.

THE Electrical Supply Co., of Hamilton, Ont., Limited, has changed its name to Electrical Power and Manufacturing Co., of Hamilton Limited.

R. C. C. TREMAINE and others, of Exeter, Ont., have been incorporated as the Exeter Electric Light and Power Co., Limited capital, $15,000.

THE street railway in Victoria, B.C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

A BOILER explosion occurred recently at the Chambers Electric Light Works, Truro, N.S. The fine new engine lately put in was seriously damaged. None of the employees were injured, though there were some narrow escapes.

WILLIAM BATHGATE, for 14 years manager of the Electric Light and Gas Company, Winnipeg, Man., has resigned, the company having been amalgamated with the Electric Street Railway Company. No successor will be appointed.

THE directors of the Halifax Street Railway have decided to issue an additional $200,000 worth of stock. This will make the capital of the company $800,000. The new stock will be issued to shareholders on record in the proportion of one share to every four held. A quarterly dividend of 1¼ per cent. was paid Oct. 1st.

THE Bridgewater Power Co., Bridgewater, N.S., has lately been reconstructing and enlarging the electric light plant, and has replaced their three-wire system by an alternating current system, for which purpose they they have purchased a 40 K. W. "S.K.C." two-phase generator from the Royal Electric Co., and 600-light capacity in transformers.

GEO. EASTERBROOK, who is about taking his departure for Delago Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This, we believe, is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

THE Kingsville Electric Light Co., a corporation recently organized in that town, has decided to light the town, stores and residences by electricity, displacing natural gas, and for this purpose has bought from the Royal Electric Co. an "S K.C." 500 light two-phase generator, with the necessary transformers and material requisite to wire up 500 lights, which is the amount intended to start work with. The Kingsville Electric Light Co. has made a contract by which it will use natural gas for fuel. It is intended to furnish incandescent and arc lights, as well as motors.

THE Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes being made is the substitution of electricity for gas. They have placed their order for a 30 K. W. Generator and 250 lights installed, with the Royal Electric Co. The generator is to be of the "S.K.C." two-phase type, wound to deliver 110 volts direct to the mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

THE Penman Manufacturing Co., Paris, Ont., which operates some of the largest mills in Canada, has made a number of improvements and additions to the mills in Paris lately, and among the improvements has decided to light their mills by electricity. The contract for a 500 light "S.K.C." machine and the wiring of the factories has been awarded to the Royal Electric Company, which purpose using for this its "S.K.C." two-phase alternating current apparatus; the dynamo wound to deliver to the mains current at a pressure that can be used directly in the lamps, from 100 to 115 volts. This is the first instance in Canada where alternating current is used for factory lighting. It has been held heretofore by electrical manufacturers that it was not practical to use alternating current for factory lighting. This plant will be a demonstration of the incorrectness or otherwise of the theory.

E. W. CUMMINGS is engineer in charge of the water-power development of the Kootenay, B.C., Electric Co.

THE ratepayers of Lanark, Ont., recently expressed themselves at a public meeting as strongly in favor of the Lanark county electric railway.

THE electric plant belonging to R. Prefontaine, at St. Agathe, has recently been considerably enlarged; a new dam and power-house have been built.

THE London, Ont., Street Railway and the London township council have come to terms, and the street railway extension to Pottersburg is to proceed at once.

C. B. MCALLISTER, Peterboro, Ont., is lighting his new flouring mill by electricity, and has placed his order for the dynamo and fixtures with the Royal Electric Company.

AT Magog, Que., a special committee of the town council has reported in favor of borrowing $10,000 to purchase an electric light plant and develop the water power.

IT is reported that Duncan McDonald, superintendent of the Montreal Street Railway, will shortly assume the duties of General Manager of the Toronto Street Railway.

AHEARN & SOPER, Ottawa, will build the telegraph line on the New York and Ottawa Railway from Ottawa to Moira, N.Y. It will include a cable across the St. Lawrence River.

A. W. PETTES and E. E. Mills have arranged with W. Foster, Knowlton, Que., for the power to run the electric light. It is intended to give an all-night service to residents and on the street at a reduced rate.

THE Stevens Manufacturing Co., London, Ont., advertises for sale in another column, a number of machines in good running order which have been replaced by its improved Eastern or Imperial apparatus.

AN English syndicate with large capital is said to be negotiating for the purchase of Canadian lighting companies, both gas and electric. The purchase of Fredericton, N.B., gas company is said to be under negotiation.

AN Ontario charter has been granted to F. N. Saylor, G. M. Haldane, J. C. Scott, A. Reed, H. McColl, Strathroy, Ont., as the Strathroy Electric Co, Limited, to supply heat, light, and power; capital, $20,000.

THE Hamilton Board of Works recently put through the Hamilton, Chedoke and Ancaster Electric Railway by-law of incorporation. It gives the road the right of way on Queen street south from Aberdeen avenue to Beckett's Mountain-drive. At Aberdeen avenue the H., C. & A. is empowered to cross the H. & D. line and run along the street railway tracks from Herkimer street to James and King. The new road has to be running by 1899, and will have a charter of 20 years.

H. M. WHITNEY, Boston, Mass.; F. S. Pearson, New York; James Ross, Montreal; Wm. McKenzie, Toronto; W. B. Ross, Q.C., Halifax; R. C. Brown, Halifax; B. F. Pearson, Halifax; R. D. McGibbon, Q.C., G. C. Cunningham, and W. B. Chapman, Montreal, have secured a charter and franchise from the Jamaica Government to build electric tramways on the island, which will need $500,000 capital or more. Montreal and Halifax capitalists are to furnish most of the money. The earliest construction will be in the city of Kingston and its suburbs. A large power house will be built on the foreshore, and electric lighting will also probably be provided.

THE Dominion Government has recently, under the superintendency of D. H. Keeley, C.E., completed forty more miles of the telegraph line on the north shore of the St. Lawrence from the former terminus at Pointe Esquimaux, and an office has been opened at Piastre Bay. It is intended to extend the line 488 miles more to Natashquan, where an office will be opened this Fall. The North Shore line will still be about 250 miles from Belle Isle, but it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal.

THE Berlin, Ont., Gas Co. has been operating an incandescent lighting plant on the three-wire system, but are now extending the incandescent lighting service so as to furnish light to the residential portion of the town. It has been decided to use alternating current, and the order has been placed for the new equipment with the Royal Electric Co., using the "S.K.C.," system throughout. Extensive alterations have been made in the station, and there are now in position two 100 k.w. Edison 500-volt generators for furnishing current to the Berlin and Waterloo Street Railway. The company also operates a local power service from its three-wire low tension system besides furnishing the town with arc lamps, for which purpose it operates two 50-light, 4 amp. Ball dynamos.

THE proposed purchase of the Chemong and Lakefield railway lines and their conversion into electric roads, which is announced as being under negotiation, would mean a great deal for Peterboro, Ont.

THE Whitney Electrical Instrument Co., of Penacook, N.H., and Sherbrooke, Que., have issued the following circular to their patrons in Canada; "We beg to inform our friends and patrons that C. E. Shedrick will hereafter manufacture and sell our line of apparatus in Canada. In transferring to him this branch of our business, we bespeak for Mr. Shedrick a continuance of the very cordial relations that have always existed between our customers and ourselves, assuring them in advance of an honorable and business-like treatment at his hands." We may add that Mr. Shedrick will have sole control of the manufacture and sale of the well-known Whitney electrical measuring instrument in the Dominion. He has been manager for the American Company for the past five years, during which he has worked up a large business, and now starts on his own account with a thorough knowledge of the trade, and the good will of a large clientele. Mr. Shedrick has a well-equipped laboratory of his own, and has been the inventor of a number of very ingenious devices in the way of electric alarms, regulators, etc. In addition to the manufacture of the Whitney instrument, he is sole maker in Canada of the celebrated Knott X-ray and therapeutic machines. The factory will remain at Sherbrooke."

## Railway Matters.

A CENTRAL office building for the G.T.R. in the business portion of Montreal is spoken of.

THE Baie des Chaleurs Ry. Co., has succeeded, it is said, in raising the money to carry on construction.

W. NEWCOMBE, Hamilton, Ont., has been appointed road foreman of the locomotive department of the G.T.R.

OWING to the increased business on the C.P.R., 200 flat cars have been ordered from Rhodes, Curry & Co., Amherst.

THE C.P.R. has placed an order for 100 box cars with Crossen & Co., of Cobourg, Ont., who have been delivering in Toronto at the rate of five per week, commencing Sept. 13th.

THE G.T.R. has decided to build a thousand box cars for freight traffic. Of this number 500 will be built in Canada at the shops in Montreal and London. The other 500 have been contracted for in the United States.

THE directors of the Quebec Bridge Company are calling in twenty-five per cent. of their subscribed capital before November 15th. Meanwhile the work of verifying the soundings at the proposed site between the Chaudiere and Sillery is being actively pushed forward.

J. B. MCARTHUR, president of the Rossland, B.C., Board of Trade, said after a recent conference with Mr. Shaughnessy, vice-president of the C.P.R., that the C.P.R. will build a line to Rossland at once, and capitalists connected with the company will erect a smelter there, so that Canadian ore can be smelted in Canada.

THE Canadian Pacific Railway Company has completed surveys for steam tramways to be constructed across the portages, and connect Lake Wabigoon with the Manitou chain of lakes and the latter with Rainy Lake, giving easy facilities for transportation of supplies to all points in the Manitou and Seine River mining regions, and also completing a circuit from Rat Portage to Wabigoon.

THE I.C.R. extension to Montreal is being rapidly pushed. The grading is now completed, and the rails will shortly be laid, and construction trains can run through from Levis to St. Hyacinthe. There are six trains and six hundred men employed on the extension; the masonry on eleven bridges is progressing rapidly; three new stations are being built, and the manager says there will be no trouble in opening through traffic on November the first.

THE Robb Engineering Co., Amherst, N.S., has just constructed and tested a locomotive for the new Pole Railway, running from Weymouth, Digby county, to New France. It resembles an ordinary locomotive, boiler and engine mounted on a flat car, the wheels of which are concave to fit the wooden rails of the road, which are about a foot in diameter. Some years ago McPherson & Co., of Oxford, made one for the Fossil Flour Company, of Bass River, but this boiler was of the upright pattern.—*Colchester Sun.*

A REMARKABLE test of a recently patented train signal was made a short time ago on one of the Canadian Pacific stock trains between Winnipeg and Montreal. This new device—the invention of Rev. Prof. Devine, S.J., of St. Mary's College, Montreal—enables railway companies to use electricity for signalling purposes, instead of the bell-rope or compressed air. Prof. Devine claims for his train signal three

important functions: First—It enables trainmen to keep up communication between the van and engine while trains are in motion. Secondly—On long freight trains, signals may be given instantaneously to front and rear trainmen from any car in the train. Thirdly—Danger signals are given automatically to front and rear directly a train breaks in two. The reverend professor personally superintended the recent successful test on the Canadian Pacific.

THE Canadian Pacific Railway have nine parties in the field at present locating the line of the Crow's Nest Pass Railway. The following well-known Eastern engineers are in charge of these parties: Chas. Garden, of Winnipeg, and E. Force of Ottawa, are locating the line west of the Pass to Michael Creek. Wm. McCarthy, of Ottawa, and Wm. Burns, of Renfrew, are completing the location along Elk River west to the crossing. H. W. D. Armstrong, of Toronto, is working between Elk River and Kootenay River. G. H. Garden, of Montreal, is closing up his work between Fort Steele and Cranbrook. W. S. Cranston, of Ottawa, is locating some heavy work along Moyie Lake, and W. J. Earl and G. Hannington, of St. John, N.B., are locating the line between Moyie Lake and West Kootenay. The location of the line will soon be completed to West Kootenay.

THE reported discoveries of very rich gold bearing quartz in the Michipicoten district of Ontario are yet unconfirmed. While there is certainly gold there in considerable quantities, the extent of the deposits will not be known till Prof. Wilmott, who has been sent out by the Ontario Government, makes his report.

### FIRES OF THE MONTH.

Aug. 31st.—G.T.R. station, at Deseronto, Ont.——Aug. 31st.—A. H. Davidson's saw mill, Colpoy's Bay, near Wiarton, Ont.——Sept. 5th.—W. N. Roberts' sash and door factory, Renfrew, Ont. Loss, $15,000.——Sept. 7th.—David Donaldson's planing mill, Lanark, Ont. Loss, about $4,000.——Sept. 17th. McMillan's 30,000. bushel elevator, at Emerson, Man. Loss, $15,000.——Sept. 17th.—The St. Maurice Lumber Company's saw mill, Three Rivers, Quebec. Damages, $80,000; insurance, $40,000.——September, 20th.—The Hull Lumber Co.'s mill, Ottawa. Loss, about $100,000.——Sept. 20th.—The Goldie Milling Co.'s cooper shop, Highgate, Ont. Loss, $400.——Sept. 21st.—Terreall & Racine's foundry, Quebec, moulding shop and pattern room. Loss, $15,000.—— Sept. 24th.—Damages to extent of $1,000 to the moulding shop of Kingston foundry.——Sept. 28th.—Gillies & Co.'s shingle mill, Sand Point, Ont. Loss, about $8,000.——Sept. 29th.—Perry & Black's sawmill, Fergus, Ont. Loss, $1,200.——Oct. 4th.—Damage to Central Prison, Toronto, twine and broom factories, $80,000.—Oct. 5th.—Damage to Graham Nail Works, Toronto, amounting to $150.

## Personal.

P. S. ARCHIBALD, C.E., late chief engineer I.C.R., is practising as a consulting engineer.

I. C. BURPEE has been appointed to succeed W. B. Mackenzie as assistant engineer, I.C.R.

H. M. JACQUES, B.A.Sc., has been appointed demonstrator in mining, in McGill University.

THE death occurred recently at Truro, N.S., of James Odell, C.E., at the advanced age of 75 years.

ALEX. BEGG, editor of the *British Columbia Mining Record*, is dead, at Victoria, B.C., aged 65.

JOHN STARK, a boiler-maker in the C.P.R. shops, Toronto Junction, was run over and killed by a train at Guelph, Ont., recently.

J O. Wisner, who was one of the earliest manufacturers of agricultural implements, in Brantford, Ont., died at his home there, Oct. 3.

ROBERT PATTERSON, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

E. HAY, a member of the Amalgamated Society of Engineers, who was employed as engineer by the Montreal rolling mills, died suddenly, Sept. 24th.

THE governors of the Kingston, Ont., School of Mines have appointed H. R. Landis, New York, mining engineer for one year at a salary of fifteen hundred dollars.

M. F. CONNERS, B.A., Sc., analyst and assayer, Bank Street Chambers, Ottawa, whose card appears in another column, announces that he is prepared to make analyses and assays of ores, minerals, etc.

THE chair of mining engineering, at the Kingston, Ont., School of Mining, has been filled by the appointment of Courtney De Kalb, who lately resigned a similar position in the Rolla School of Mines, in Missouri, U.S.

F. J. RASTRICK, architect and civil engineer, died on the 13th September 13th, at his residence, in Hamilton. He was a native of Staffordshire, England, and had resided in Hamilton since 1853. He was a member of the council of the Ontario Association of Architects, Toronto, and was instrumental in establishing the Public Library and Art School in Hamilton.

## Marine News.

J & R. WEIR, Montreal, recently launched a tug which they built for W. Davis & Sons, contractors.

A. DEVOE, Cape Breton, and John F. Devoe, of Little Bras d'Or, have invented a one blade spiral propeller.

JOSEPH L'ETOILE, of Ottawa, has invented a submarine searchlight which was, it is said, successfully tested in the Ottawa River recently.

THE amount of freight handled this year by the steamers plying between Toronto and Montreal, is the largest in the history of both the R. & O. Navigation and Merchant Line steamers.

POTTER BROS., of Canning, N.S., have completed their steamer the "Beaver," which will at once be put on the route between St. John, N.B., and Parrsboro, Canning and Wolfville, N.S.

IT is said in London that Sir Weetman Dickinson Pearson's company has submitted a proposal to complete the canal from Ottawa to Georgian Bay, on conditions which are believed to be satisfactory.

CAPT. COATES, Fort Frances, Ont., and Capt. Mosher, are building another steamer, "City of Alberton," for service on Rainy Lake. It will be somewhat similar to the "Maple Leaf," but a little more elaborate in finish.

PLANS and specifications are out for the construction of a very large barge to carry coke-laden cars from Comox to Vancouver, B.C. The craft, which is to be built for the Messrs. Dunsmuirs, will be capable of receiving twelve loaded cars at a time. It will be 190 feet long, and will have a beam of 45 feet.

A CHANGE has been announced in the eastern terminus of the Canada Atlantic Railroad from Rouse's Point, N.Y., to Swanton, Vt., and the extension of the line west from Ottawa to Parry Sound, by which it is proposed to open a new trunk line between the great lakes and New England points. It is stated that a line of steamboats will be run from Chicago to Parry Sound, and at Swanton the Canada Atlantic will connect with the Central Vermont and the Boston and Maine Railroads.

MR. MARGARCH, the Government engineer, has recently returned from Manitou, where he has been building a dam, which enables vessels of four feet draught to get within seven miles of Rainy Lake, thus making navigation possible over a distance of sixty miles. Instructions have also been received from the department instructing Mr. Margarch to go on with the building of another dam at Dryden, on Wabigoon River, which will raise Lake Wabigoon to high water level and make another stretch of forty miles of water navigable. So that from the track to Fort Frances can be reached by making two portages only. There are now four steamers on the Wabigoon, and one on the Manitou.

A. P. Low, of the Geological Survey, who went to Hudson Bay last spring with the "Diana," has returned to Ottawa. The "Diana" entered Hudson Strait on Jubilee Day, June 22nd. On July 6th, she met thick weather, and was fast in an ice pack; on the 9th she reached loose ice, and on the 12th clear water in Hudson Bay. On July 16th, Mr. Low's party were landed near Douglas Harbor, a place Mr. Low describes as affording first-rate shelter. On the 18th, the "Diana" steamed away and Mr. Low set forth on his coastwise journey eastwards. On the 26th their yawl became fast in the shore ice and remained until Aug. 1st. It was on Aug. 1st the party reached Stupart's Bay, where some years ago the observer, after whom the place is named, established a station. The party reached the southernmost part of Ungava Bay on Aug. 24th. There at Fort Chimo they found the Hudson Bay Company's steamer "Erik," which had arrived on the 20th from Fort Churchill on the west coast of Hudson Bay, the earliest passage on record. The captain reported, however, that the ice pack had been the most formidable in his experience of six years' navigation of these waters. From Fort Chimo, Mr. Low made a trip in his sail boat across to George River, on the east side of Ungava Bay, returning on Sept. 7th, Next day the boat and her outfit were put on the "Erik," which took them out of the strait and around to Nachvak on the Atlantic coast. Dr. Bell and his party made a very successful survey of the coast. They also traveled for seven days into the interior of Baffin Land, and discovered an immense lake over 80 miles long. He further explored the region for gold, but found nothing of much practical use.

THE Kootenay River and Transportation Company has a steamer well under construction at Jennings, B.C., for the Fort Steele trade on the Kootenay. She will be 150 feet over all, 30 feet beam, tonnage 250. Her cylinders are 12 inches in diameter, 12-foot stroke. There will be 22 staterooms, electric lights, searchlight, etc.

THE work on the new steamer now building at the shipyard, at Belfast, Ireland, for the service between Liverpool and America for the Dominion Line, is progressing favorably, and the ship will be delivered at Liverpool on April 1. The Dominion Line have decided to name the new steamer "New England" instead of "Dominion," as was at first intended. The "New England" will be 50 feet longer than the "Canada," three feet wider beam and two feet more depth of hold. She will carry a cargo of about 15,000 tons measurement. She will have more passenger accommodations than the "Canada," the first cabin staterooms being more spacious and somewhat of an improvement in the way of furnishings and decorations.

---

A NEW town site is being surveyed on the shores of Lake Winnipegosis, where the Dauphin Railway will terminate.

H. CORBY, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamo, etc., with the Royal Electric Co.

THE Jenckes Machine Co., Sherbrooke, shipped recently one of its heavy 50-h.p. slide-valve engines, with standard steel tubular boiler, to Desire Thibault, East Hereford, Que.

D. CHAMPOUX & BRO., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30-inch Crocker Turbine from the Jenckes Machine Co., of Sherbrooke, Que.

THE Ottawa lumbermen have been notified by the Minister of Marine and Fisheries that the law forbidding the dumping of sawdust into rivers will be enforced at Ottawa after July 1st.

THE power station for the Sherbrooke Street Railway, at Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed.

THE Chicoutimi Pulp Co. is adding another 40 inch Crocker turbine, arranged to work under 70 foot head, which is being supplied by the Jenckes Machine Co, Sherbrooke, making the fourth of these wheels supplied.

THE dam at Magog, Que., for the civic electric light plant is completed, and the 55-inch Crocker water wheel, which is being furnished by the Jenckes Machine Co., Sherbrooke, is expected to be installed now within a short time.

THE screens and wet presses furnished by the Jenckes Machine Company, Sherbrooke, are now arriving at the Morgan Falls mills of the Acadia Pulp and Paper Co., and the whole plant is expected to be in operation within a short time.

THE Dominion Paper Co., which is extending and enlarging its mills at Kingsey Falls, have placed an order with the Jenckes Machine Co., Sherbrooke, for two of their 30-inch Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with gearing and attendant evils.

WATER was turned into the flume at the factory of the Boston Rubber Co. at St. Jerome on the 25th ult. The steel flume, which is 350 feet long, 6 feet in diameter, was furnished complete, including a 55-inch Crocker wheel, by the Jenckes Machine Co., Sherbrooke, Que.

THE Shawenegan Falls on the St. Maurice, have been sold at auction for $50,100 by the Quebec Government, Sept. 9th, to D. Russell, Montreal, representing a syndicate which will produce calcium carbide. Within 18 months $4,000,000 will be expended in development. The power reverts to the Government on failure to fulfil these conditions.

WM. WATSON, Toronto, recently visited the Penetanguishene Hotel at Penetang, and made a thorough inspection of the sewage disposal works. Mr. Watson reported the plant as of admirable design and construction, and only requiring careful operation to make it a complete success.

MARSH & HENTHORN, who succeeded to the business of the G. & J. Brown Mfg. Co. of Belleville, have been very successful since they took over the establishment last summer. They have made 20 lumber cars for Gilmour & Co.'s yards at Canoe Lake, Ont., and 15 cars for the Soulanges Canal. They have supplied four steam hoists to Wm. Gibson, contractor, two for the quarries and two for work on the Victoria Bridge, Montreal. The quality of their work has been very favorably commented on.

"MINERAL Wealth of Canada," by Arthur B. Willmott, Professor of Natural Science in Macmaster University, has just been issued from the press of Wm. Briggs, publisher, Toronto. It is a guide to the study of the economic geology of Canada. The ordinary student of the mineral deposits of Canada has not the opportunity of digesting the contents of the reports of the Geological Survey, but this work of 201 pages contains in a small compass the main facts conveniently arranged and in language as plain as can be employed. One good feature is that not only is each mineral found in Canada described, as it were, in a "character sketch," but an account is given of the uses to which it is put, and where it is found in Canada, as far as known. A list of authorities on each topic is given for the convenience of those who wish to follow up the subject more fully. The topics treated of are iron, manganese, chromium, nickel, cobalt, copper, sulphur, gold, platinum, silver, lead, zinc, arsenic, antimony, tin, aluminum, mercury, salt, gypsum, barite, apatite, mica, asbestos, actinolite, talc, peat, coal, graphite, petroleum, asphalt, albertite, anthroxalite, granite, sandstone, clay, slate, limestone, marble, lithographic stone, cement, fertilizers, etc. Recent statistics of production are given in most cases.

THE most interesting catalogue on acetylene gas generation yet issued is that of the Niagara Falls Acetylene Gas Machine Company of Niagara Falls, Ont. Besides a description of the method of manipulating the machine, it gives a variety of useful notes and statistics relating to the properties of acetylene as an illuminant. Those interested in the subject will find many valuable points in this catalogue, which will be mailed free on application.

IN the June issue of THE CANADIAN ENGINEER a selected paragraph appeared which gave the error recently established in the longitude of Montreal incorrectly. We append the correct figures, as contained in Prof. McLeod's report: "The final value of the longitude of Montreal (the middle point between the two piers of the transit instruments at this observatory), as determined from the observations of Professors H. H. Turner and C. H. McLeod in 1892, is 4 hours, 54 minutes, 18.67 seconds. This quantity is in excess of the old value, which was obtained by connection with the United States system of longitude, by 0.105 of a second. The determinations upon which the American longitudes have hitherto rested were made by the United States Coast and Geodetic Survey in 1866, 1870 and 1872. When it is considered that the cable signals were then sent by the old flash system, and that the longitude operations, as conducted by the Americans, did not include an interchange of observers, the accordance of the old value with that above announced is quite within the limits of error, which might properly have been assigned to the former."

A VERY interesting experiment with asbestos plaster took place recently, at Washington, in the northwest court of the United States Treasury Department building. It was a practical demonstration of the merits of this plaster for the benefit of the officials of the Supervising Architect's Office. Those present were Mr. Fouche, chief computer; Mr. Raymond, in charge of testing and experimental work; Mr. Adams, chief of the heating and ventilating department, and Chief Engineer Watts. In the court was placed a structure representing a miniature house, the roof of which was about four feet high, the interior being plastered with "asbestic," the name by which this new wall plaster is known. Around the structure were piled kindling wood, shavings and paper enough to make a bon-fire to celebrate a great political victory. After being ignited, the light structure was immediately enveloped in flames, which burned fiercely and furiously, but to no avail, as they had found a master. After being subjected to the fire for half an hour an important test was made. A stream of water, through a one and a-half inch nozzle, was poured on the plaster attached to the sides and roof without any effect. The plaster did not drop or crack, but was intact, demonstrating conclusively that it was fire-proof and far superior, in every way, to any plaster now on the market. Asbestic is manufactured by the H. W. Johns Manufacturing Company of New York.

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# The Canadian Engineer

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*For* THE CANADIAN ENGINEER.

### RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

#### CHAPTER IV.

#### ARTICLE 11.—SURVEYS.

The final determination of the exact centre line of a railway roadbed and track is only reached after a process of sifting, which extends from the first thought of the necessity for such a railway until the track is laid. Roughly speaking, it is usual to divide the operations into three stages, which, however, often overlap each other, or are again divided into subsidiary steps. These customary general divisions are:

(1) Reconnaissance.
(2) Preliminary or Trial Line Surveys.
(3) Primary and Revising Location Surveys.

#### ARTICLE 12.—RECONNAISSANCE.

Reconnaissance may be said to begin after it has been decided that there is a necessity for a railway between two given terminals, or along a given route.

In the latter case, local considerations, or the shortness of the distance, or the existence of a definite water line route, may limit the scope of explorations, but looking to the larger problem, where an engineer has to determine what is the best route between two terminals several hundred miles apart, the study is interesting and one requiring a high order of talent. If the country to be traversed is unsettled, or thinly settled, the problem is simplified by lack of railway competition often, or even by considerations of traffic, but it then demands a close investigation of the natural resources of the country, which, though dormant, will be developed by the railway itself, and it might be considered best, all things considered, to build sometimes, at a sacrifice of distance, grades, or capital outlay, through a country of great natural resources, rather than through a barren one by a route physically superior. On the other hand, through a populous country, the question is much more complex, by reason of the existence of other railway routes already established; but, on the other hand, simplified by a more or less well defined trend of population, which indicates the probable future distribution of people in accordance with natural laws. For these and many other reasons, exploration should commence and be well under way, or even completed, before instrumental work commences; it should, at least, be completed for such a distance that some critical place has been reached through which the final location must pass.

In order to finally fix on the best route between two defined points, it is necessary to study a wide belt of country; even a great number of trial routes will not answer so well, because portions of various routes may be finally selected and joined together. In order to explore such a wide belt of country, use must be made of all existing maps. These when made from governmental surveys will be found of extreme service as a skeleton on which to build such additional information as may be necessary to complete the study in hand. All streams, summits, passes, etc, within the extreme margin of possible routes should be accurately fixed in plan and elevation. A knowledge of the classes of timber, stone, and excavations, and of difficult river crossings, etc., should be included, and from such data, together with closely estimated lengths of lines, ruling grades (obtained from barometer heights), probable traffic, cost of construction, difficulties of maintenance and dangers of future or present competition. A selection is made of the two or three most favorable routes, over which it is thought necessary to make instrumental surveys.

In carrying out reconnaissance, the instruments required will depend on the class of work to be done. These should always include an aneroid barometer, a Locke level, a pocket or prismatic compass and a field glass; distances may be determined from maps, if existing, by pacing, by the rate of travel of a horse, or if in open country, it will be better to take the time to determine them by stadia or some form of telemeter. The aneroid barometer is an instrument supposably compensated for temperature, and under static air pressures capable of always reading the same at the same altitude; but errors in graduation, in workmanship and adjustment, and the barometric changes going on in the atmosphere make it far from a precise instrument. In order to make it available, each instrument when purchased should be rated alongside a mercury barometer, and only those

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

which have a reasonably uniform and small rate of error should be accepted, so that a table of such errors can be prepared and used in conjunction with actual readings taken. Aneroids in high altitudes are often much in error, and generally speaking, should be used to obtain *differences* in elevation rather than actual ones. If a barometer is read at the same spot every hour for a day, a continual fluctuation will be noticed, even during bright dry weather and very much more so during periods of storm or change; these readings if plotted may be termed the *diurnal gradient*. It is evident, therefore, that readings from an aneroid taken at various places, at different times, even during the same day, will not be reliable, and in order to make such readings of value, there should be another stationary aneroid read at regular intervals, and the readings of the moving aneroids corrected according to the fluctuations observed at the central point. Should only one aneroid be available, it would be better, where possible, to make two or more determinations of the same points at different times, to get an average, and to work only when the atmosphere is in a settled condition. Equipped with the above-mentioned instruments and one or two assistants, the engineer on reconnaissance should go into the field free from prejudice; the well-known wagon road or trail may be very convenient to travel along, but not necessarily in the vicinity of the best railway location; the river flowing between or in direction of the termini may have precipitous, treacherous banks, be crooked in alignment, and afford not nearly so feasible a route as the upland country adjacent; just beyond a certain forbidding range of hills may lie a direct and cheap route, and a pass through the barrier may really exist, being hid in the distance by an overlap. In fact, the frame of mind suitable for such an undertaking should be optimistic, ready to believe that if only time enough is available, the best route can be found, but at each moment doubting that such a route is yet discovered.

In addition to those general economic considerations which have been touched on in previous chapters, it is well to remember, amongst other things,

(*a*) That lines following large streams will usually require heavy bridge work and masonry in crossing tributaries.

(*b*) That one bank of a river may be much better than the other, and that it may even pay to cross the river at rare intervals to secure alternately favorable stretches of construction.

(*c*) That lines on side hills are more costly to maintain than those through level country, owing to the sliding and washing that takes place.

(*d*) On the other hand, that a cross-country line, usually, will cross many summits, and even when skilfully located, and often at a considerable loss in distance, will abound in curvature and maximum grades.

(*e*) That in each locality will be met men who have an intimate knowledge of the minutiæ of the surrounding country. Many of these look on themselves as born locating engineers, and while their ideas on grades and curves are usually misty, every shrewd engineer will not be averse to the valuable aid which such men voluntarily offer; the only difficulty lies in sifting the wheat from the chaff without giving personal offense.

(*f*) That the engineer of reconnaissance and afterwards of surveys is the first officer of the railway company to be thrown in contact with the people who are to become the future patrons of the road, and, as such, his manifest duty is to make as many friends for his company as he can, consistently with his other duties, and enlist their sympathies in its favor; in this way a much more reasonable spirit will be created which will display itself when right-of-way questions begin to arise.

After a complete study of the intervening country has taken place, a rough sketch map should be made from the notes taken, and other existing ones, on which will be shown the positions of all streams, summits, etc., with elevations marked at critical points, then possible routes will be indicated, calculations made of the length of lines, maximum grades, probable amounts of curvature, approximate cost of constructions, present and future traffics, etc., all of which, although much in error, will usually narrow down the question to two or three routes which are selected as the most likely and suitable ones for instrumental surveys.

### Article 13.—Preliminary or Trial Line Surveys.

The roughest class of preliminary survey may be an amplification of reconnaissance, in which a small party of three or four men pass rapidly over several proposed routes at a rate of five to fifteen miles per day to determine what grades can be obtained before more accurate survey begins. In open country rapid progress can be made, using stadia for distances and using vertical angles for elevation or depression, which are checked by an aneroid barometer. In a wooded country the distances will be determined more rapidly by chain and compass, and heights by aneroid. Side slopes may be noted at difficult spots by some form of clinometer. What is usually wanted is to know what grades can be obtained at certain critical points, in order to adopt a ruling grade for the route. The instruments required are a light transit with stadia hairs, compass and vertical arc, a stadia rod, an aneroid barometer, a clinometer, a 100 ft. steel chain and 50 ft. linen tape. On this class of work the error of stadia measurement should not be more than 1 in 1,000, which is more accurate than rough chaining. When a full survey party for instrumental work is to be equipped, a variety of causes tend to determine the men and instruments required.

(*a*) In an open rolling country. If contour lines are not needed, the party will usually consist of—

Chief of party,
Transitman,
Leveller. } Engineers, preferably all experienced.

Rodman,
Front Picketman,
2 Chainmen. } Active young men, preferably educated college graduates, not afraid of work.

2 Axemen,
1 Stakeman. } Seasoned workingmen, used to bush life, axes, and hard work.

If under canvas, add one cook and one assistant cook, and in this kind of country always use a transit.

(*b*) In thickly wooded country, without iron ore, better results, for the same labor, will be obtained by using a 12-inch to 16-inch compass, instead of a transit, avoiding many detentions, useless cutting of trees, etc. The compass has no cumulative error, and will give good results where no contours are taken; if contours are to be taken, it is better to establish transit line for future use. In a wooded country two or three extra axemen will be needed to make rapid headway; the front picketman also, in this case, should be an expert axeman, and lead the others.

(*c*) If the country is much on side-hill, another party is needed in addition to the transit and level parties, whose duty it is to take contours. In the past contouring has often been omitted, and although there have been some men of great natural talent and long experience who have been able to locate well, even through very rough side-hill country, by eye alone, yet even to such men a properly conducted contour survey would have been of great advan-

tage. It is becoming more fully realized every day that a contour map, with a location line laid on it in the office and revised afterwards, where necessary, in the field, is a very valuable part of preliminary surveys in such a kind of country. This topography party consists of two or three men, equipped with a level board, level rod and hand level, or else with a clinometer and tape to measure side slopes; the work is carried on one day behind the level party, and the method of procedure is somewhat thus:

Detached sheets of paper about 18 inches by 24 inches, have plotted on them the centre line and level height at each 100 feet and hub, according to the previous day's records; these sheets are mounted on a drawing board and taken into the fields, where 5 feet or 10 feet contours are plotted and sketched direct, for a distance of 20 to 50 feet in elevation, up and down hill from the centre line, depending on evident requirements; with a little practice, the distance to each contour can be taken and plotted very rapidly, obviating the necessity of notes. Intermediate irregularities, etc., can be also sketched in by eye, and the sheets when taken back to the office can be placed in proper alignment and chainage, and a tracing taken if necessary; but probably the projected location line will be at once placed on these sheets and then transferred to the field at once, or by another party following, or the whole matter may be held over until a decision is arrived at as to the correct location route to adopt; this will evidently vary with each case. If the contour notes are recorded in books in the field, they may be plotted on a continuous roll in the office; but such a method is more tedious, and little irregularities which would be sketched in the field are often omitted in notes. A topography party relieves the transitman of all note-taking except centre alignment, whereas all notes of natural and artificial topography are taken by the transitman where no topography party is employed, thereby delaying the progress of the whole survey. A topographer should preferably be a Provincial Land Surveyor also, so that his work in recording land lines and making plans may at once be legalized.

The qualifications and duties of the members of a survey party are somewhat as follows:

*The Chief of Party* should be a man of vigorous mental and physical attainments, familiar with the details of survey life and minutiæ, with a wide experience of construction, and even, if possible, of maintenance of railways, well informed on such matters as have been touched on in previous chapters, and capable of commanding prompt obedience and zealous assistance on the part of every member of the party. If, in addition, a man can be found who has also a natural genius for railway location, he cannot be too highly treasured or paid. The chief of a survey party is the most important position in the pay of a railway company where location is of a difficult and perplexing nature. Crippled constitutions and receiverships are more often the result of poor location than from any other cause, hence the high value of the men who decide on such matters. A chief may be a strict disciplinarian and still command the regard of his assistants; he should have free scope to dismiss anyone not competent and willing to do good work; and should never do any work for subordinates, except in the rarest instance, but should be well on at the front most of the time, devising the next step before it is needed, and having in view a general plan of the country, not looking straight ahead, but feeling that just "beyond" there may be a better line. The rate of progress is fixed by those at the front, the others must keep up. A chief of party carries usually a pocket note book, or even topography book, an aneroid barometer and a pocket compass.

*The Transitman* should be an engineer of some experience, particularly in handling men, keeping full and accurate notes, and rapid and yet delicate handling of his transit. He should be alive to the general movement of the men in his party, which means that he should not always be looking through his telescope at them, but commanding their movements directly also, and above all, he should put his transit in position quickly, and not keep a whole party waiting while he dawdles over his levelling screws, etc. Where there is no topographer, the transitman, in addition to keeping notes of the survey alignment, must sketch neatly, with necessary measurements, all buildings, roads, farm lines, etc., in fact all artificial and natural topography, and obtain all owners' and tenants' names. In a level country, topography should extend for at least 500 to 1,000 feet on each side of the line, as the location may be moved that much, and thereby run through houses and barns that have not been noted. This should be done where necessary by accurate chainage offsets. In country of steep side inclinations this is not necessary; judgment will determine the width of the topography belt needed in each instance.

*The Leveller* may be a young engineer of limited experience, although preferably one capable of rising rapidly to higher position, and not one whose engineering horizon is bounded by such work. In addition to centre line levels, taken at each 100 feet station, hub, and intermediate change of vertical direction, the leveller notes the wooded and cleared portions, the class of timber, probable nature of material in cuttings and borrows; the depth, volume of flow and high water mark of all streams, and establishes bench marks, at say each half mile on preliminary surveys.

*The Level Rodman and Chainmen* should not only be instructed how to do their work, but day after day should be made to chain and hold their rods correctly; chains should be tested frequently. It is certain that more errors are due to poor chaining and rodding, to insecure hubs, and to slovenly work amongst subordinates, generally, than to poor instrumental work, although the blame for such errors is usually laid on the latter.

*A Front Picketman* is invaluable and should be distinct from the chainmen; he should be an active, intelligent man, one who can select a transit site with judgment, make and drive a hub well, take centre, make and drive reference stakes, make a cross-head for back-sight, and then, after placing his picket *exactly* on line, or laying it on the ground, continue to make stakes until the transitman arrives, or better still, if so directed, he may continue to the next site and be ready by the time the transit is placed, to take hub again. In cleared country, hubs should be driven in secluded spots along fence lines, etc., wherever possible, or else in a few months all traces of line across cultivated fields will be obliterated. If hubs come, necessarily, in open places, extra ones should be put in in sheltered spots. If the line is being carried through forest, the same care will not be necessary to preserve the line, and transit sites will depend more on natural profile; in this case the front picketman should be continually taking line for clearing, and leading, and commanding the axemen, being himself also, for the time, an axeman. In general, it is best to not have a back picketman; but have the transitman place a cross-head on line within a few inches of his transit telescope just before moving forward. If a back picketman is employed, it is best to still use a cross-head and keep the man merely as a guard and

handyman for occasional use in emergencies ; a cross-head is very accurate and never falls asleep at inopportune moments.

During survey, people naturally resent injury to crops and premises, even when the least possible is inflicted, and polite words and sincere endeavors to minimize the loss are rightful and expedient. Many survey parties constitute themselves armies of invasion ; trees are needlessly cut down, growing grain trampled on, fences torn down to make stakes, and a general tone of overruling ruthless power is prevalent, all of which is wrong and foolish. Many life-long enemies to the road have been made in just this way, and the probable immediate consequences will be that all stakes will be torn up and thrown aside as soon as the party has passed by, and, in addition, the purchase of right of way will be made needlessly difficult and expensive ; the far-reaching consequences to a railway company of the actions of survey parties in this respect are beyond calculation.

After preliminary surveys are completed, and it is desired to obtain approximate estimates of the quantities and cost of construction for a comparison of routes, various short-cuts are used. Excavation tables can be purchased or made for taking out quantities of earthwork. General plans of trestles, culverts, etc., can be used, and tables drawn up of the cost per lineal foot for various sizes and heights, but the larger structures will each require special calculations. In taking out approximate quantities, remember—

(*a*) That embankments require more than cross-section measurements indicate, by about 5 per cent. if of sand, 10 to 12 per cent. if of clay, and 15 to 25 per cent. if of loam or peat, but that rock expands 25 to 75 per cent., depending on the size of the rocks. This shrinkage will not take place fully for a year or two, and may not exist at all during hurried construction, and will be made up afterwards by train.

(*b*) That unless the depths of foundations are known, a liberal allowance should be made for possible deep ones.

(*c*) That side-hill quantities are not indicated by the centre line profile and should be specially provided for.

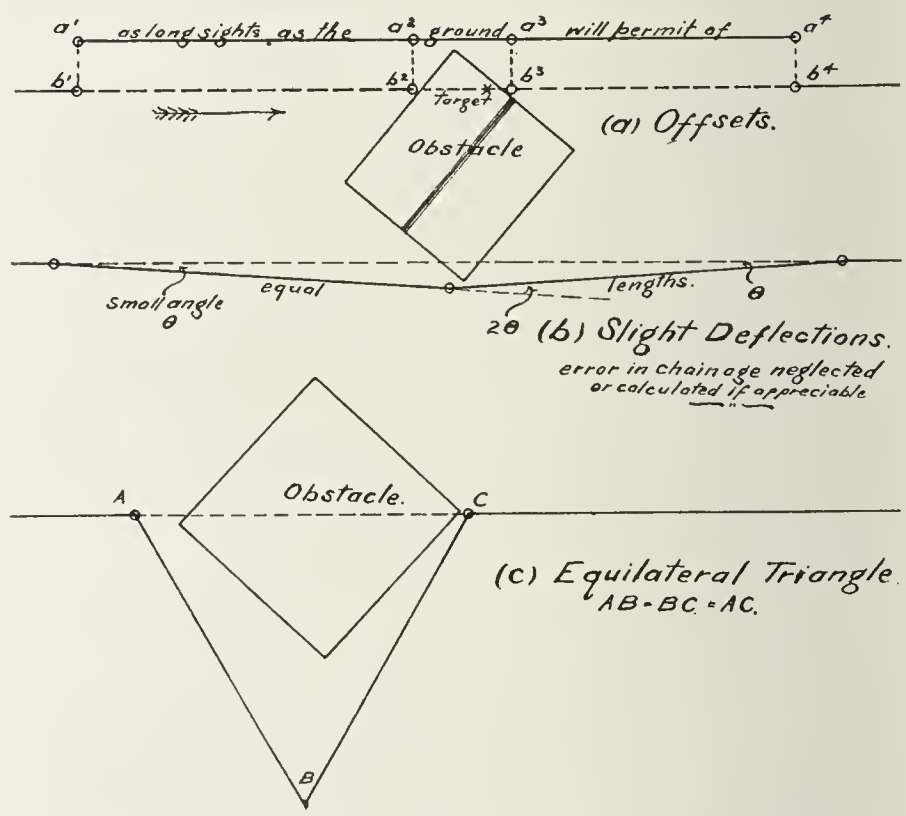
(*d*) That the classification of material is likely to be higher than surface indications would seem to warrant.

### Article 14.—Location Surveys.

The duties of each engineer of a survey party are considerably increased when the location of the selected preliminary line is decided on. The chief and transitman note the foundations for all structures, and should be given time and facilities to have soundings of the beds of the streams, etc., made, so as to determine the depth of foundations quite accurately. This may be made a part of the leveller's duties, if he has more time for it. They should carefully note the natural resources of the country passed through, whether good quarries and ballast pits exist or not; whether timber suitable for trestles, piles, or ties is available, and the probable traffic on various intersecting highways, so as to determine at each one whether it will justify the company in expenditure sufficient to pass the road over or under the railway. In fact every item of information necessary for a complete knowledge of each structure, etc., so as to be able to say definitely what structure is best at each point and why. If the topographer is not a land surveyor it will now be necessary to add one to the party, whose duty it will be to fix the exact position and angle of crossing of each property line, and measurements to nearest monuments, the bearings being taken by compass. Also to obtain the full names of all owners and tenants whose properties are to be affected, the exact positions of all buildings or highways within 400 or 500 feet of the centre line, and all prominent natural topography. The leveller, in addition to those duties already noted for preliminary work, will need to establish and witness bench marks about every 1,000 feet, not closer than 30 feet or 40 feet to the centre line, nor more than 50 feet or 55 feet in a bush country, while in an open country any convenient distance laterally will answer. Very few places should be deemed suitable for a bench mark ; the root of a large green stump, or the top of a small one, cut off for the purpose, is the best. If the root of a tree is used it will grow a little in the course of years ; it is liable to be invalidated by the wind blowing the tree over, or lifting the roots in loose soils, and worst of all, if on the right of way it is liable to be burnt up or cut down below the blaze made on the side of the trunk for reference, thereby being lost entirely. Bench marks should be selected at elevations close to structures, but otherwise at heights nearly that of the proposed grade line, so as to be convenient in running grades, ballast heights, etc. When a located line is laid down without much revision, it will, in any difficult

Fig. 19.

Methods of producing a straight line past an obstacle




country, pay by many times the expenses of a survey party, to revise the whole line, when numerous small changes will be made from point to point.

In finally staking such a revised line, it should be thoroughly done, and hubs and stakes stout and well driven, good strong nails (1-inch tinned) used. No hub should project more than half an inch above the ground, and in a settled country stakes should be bought at a sawmill and carried along a day at a time ; the using of fence rails for stake material creates more ill-feeling than the trifling economy warrants. Unless construction is imminent, all hubs should be referenced by cross lines or otherwise. Nothing is much more disheartening to the constructing engineer than to find a located line almost obliterated and untraceable. There are three general methods of prolonging a straight line beyond an obstacle.

(*a*) By offsets, where the necessary offset is not very long ; this is the most accurate method. The measurements $a_1b_1$, $a_2b_2$, $a_3b_3$, $a_4b_4$ are identical and made very carefully with a steel tape and plumb line ; the transit sites would be at $b^1$, $a^2$, $b^4$, with a target placed on top of the obstacle, if possible, as a back sight check. (See fig. 19.

(*b*) By making a slight angular deflection measuring a certain distance until just opposite the obstacle, then deflecting back twice, the first deflection measuring an equal distance and then deflecting again on to tangent, by an angle equal in amount and direction to the first one, the error in chainage is usually disregarded; this method introduces three angular measurements and is not likely to give an exactly straight line for this reason. (See fig. 19.)

(*c*) By laying out an equilateral triangle, this fixes the chainage beyond the obstacle, and presumably the direction and line; but as this method introduces three angular measurements and two linear ones, it is not apt to give as good results as the first two. (See fig. 19.) It is understood that if by placing a transit on top of a secure obstacle the line can be prolonged directly over it, it is best to do so even at considerable personal inconvenience.

If very accurate transit work is desired, it is not best to trust to the adjustment of the instrument, but take two points on each hub, and use the mean. In the same way, equal backsights and foresights in levelling should be obtained wherever possible, to minimize the result of a level being out of adjustment, and also it is best to adjust instruments for about the distance that the ordinary sights are to be in any given class of country. The travel of the tube in a large change of focus often throws an instrument out of adjustment for very short or very long sights.

It is often found that a survey party, before being disbanded, has time to do cross-sectioning for construction; this is a mistaken economy, and a source of errors and mutual accusations. The members of a survey party do not take interest in work; they are not to superintend, and the cross-sections will probably be poorly chosen and executed. Then the centre line will very likely be altered in various places, which will invalidate all sections at those points. Generally speaking, it is best to have the engineer of construction do everything of an engineering nature which appertains directly to his work.

(*To be continued..*)

## THE PETROLEA WATER WORKS.

In January, 1893, the town of Petrolea, Ont., made an agreement with the Petrolea Waterworks Company to lay about 40,000 feet of pipe, with 70 hydrants. The water was to be taken from wells in the gravel beds in the townships of Enniskillen or Plympton. In August, 1894, an extension of time was granted to the company, which had then laid only about two miles of piping. In 1895, the company having failed to carry out its agreement, owing to the difficulty in finding a well with a sufficient yield of water, the corporation began operations on its own account by sinking a test well about 4½ miles east of the town, which yielded 70,000 gallons per day, but which was not found to be permanent.

At this point Willis Chipman, C.E., Toronto, was engaged to report on the whole question of water supply. In his first report, August 27th, 1895, four sources of water supply were discussed, of which the River St. Clair and Lake Huron were found to be the best. A second report was presented to the town council by Mr. Chipman, which discussed the Lake Huron scheme. The plan here discussed was adopted by the council, upon the following estimates submitted by the engineer:

| | |
|---|---|
| Pumping station at Lake Huron, including pump house machinery, intake detached residence for engineer .... | $ 15,000 |
| Force main, including right of way and damage..... | 103,000 |
| Distributing system in town, including a sum to purchase the mains already laid by the company..... | 35,000 |
| Standpipe ..... | 8,500 |
| Meters..... | 3,000 |
| Engineering and contingencies ..... | 7,000 |
| | $171,500 |

The late Alan Macdougall, C.E., made a report upon the plans prepared by Mr. Chipman, in which he suggested a filter bed in the lake, protected by crib work, and having an area of 7,500 square feet. E. H. Keating, C.E., city engineer of Toronto, was asked to pass upon both schemes. He was in favor of an enlarged conduit pipe and intake, and other alterations which increased the estimate by about $50,000. The town council decided to proceed with the work as planned by Mr. Chipman in his report originally adopted. Work was commenced April 1st, 1896, with Mr. Chipman as engineer in charge.

During April and May the conduit line was located and staked out, the point of intake and site for building selected, and plans and specifications prepared. During this time the right of way for the conduit was secured by the committee. The contract for the whole work except machinery was let to W. Garson & Co., St. Catharines, Ont., for $131.945. The contract for the machinery and boilers was let to the Hughes Steam Pump Co., of Cleveland, Ohio, for $14,289.

The intake pipe is 1,089 feet long from the well to the strainer, and 12 inches in diameter. The depth of water at the outer end is 15 feet, with the lake at 580 feet above the sea level. The intake is so designed that it can at any time be tested for leakage, or flushed out from the pump room. At the outer end is placed a cylindrical crib, or strainer, of ¼ inch boiler plate 4 feet in diameter and 5 feet high, the upper part being perforated with ½ inch holes, spaced 1½ inches centre to centre. The top of the strainer is about 10 feet below the lake surface. It is protected by ten twelve-inch piles. The intake pipe was completed and lowered to grade in April, 1897. Considerable difficulty had been experienced in laying the intake pipe, as a sand bar 150 feet from the shore refilled the trench, which was dredged for the pipe several times.

The pipe also parted on a couple of occasions. Upon subjecting the pipe to a test pressure of 20 lbs. to the square inch, a leakage of 25 gallons per minute was determined. It was discovered that the strainer had lost its upright position owing to the sandy clay washing out from one side. It was righted by dredging under the other side, and was then connected with the wooden piles, which surround it by a heavy iron chain. It is the opinion of the engineer that the strainer will eventually have to be protected against accident by a stone filled cribwork.

The pump well is circular, with an interior diameter of 14 feet, and a depth of 12 feet below the surface of the lake when it is at 580. The floor level of the engine-room is 6 feet above this lake level, and 11 feet below the ground surface. The material passed through in excavating for the well below the floor level of the engine-room, was entirely a blue clay through which no water whatever percolated from the lake. The walls of the well are of hard brick laid in Portland cement. The top of the intake where it enters the well is at elevation 576, thus giving about four feet of head in the pipe with the present lake level. By an arrangement of pipes and valves in the well, water can be pumped directly through the intake, and water can be turned back through the intake by an 8-inch connecting pipe from the discharge main. The lower four feet of the well cannot be pumped out by the main engines, this space being left for sediment to collect, but it can be pumped out at any time through a flexible iron section pipe by boiler feed pump. The well is entirely outside the building, and is covered.

The pump-house is located on the northeast corner of lot 9, 8th concession of the township of Sarnia. It is a white brick building 30 x 100 feet, divided into engine-

room, boiler-room and coal shed. The smoke stack is of brick, 73 feet high, 8 feet square at the base, with a flue 30 inches square. Near the pump-house a two story brick house for the engineer was built.

From the pump-house to the town limits of Petrolea, the conduit line is of cast iron pipes 12 inches in diameter. The length of the line is 57,943 feet, but the 12-inch main continues 3,705 feet to the water tower, and 4,502 feet to Petrolea street, the whole distance being nearly 12 miles. All the pipes are laid to grade, most of the line having an inclination of one in 1,000 only. On the line are seven gate valves, four automatic air valves, and four blow-off valves.

The pipe was supplied by the Gartshore-Thompson Pipe Foundry Co., Hamilton, except about 15,300 feet, which was supplied by the St. Lawrence Foundry Co., of Toronto. Several weights of pipes were used, the heaviest being at the north end. The conduit line was tested by maintaining the pressure of 200 lbs. to the square inch at the pump-house, for six consecutive hours. Very few leaks were discovered, and only three pipes failed in the preliminary tests made by the contractor. This pressure of 200 lbs. at the pumping station gives 147 lbs. at the height of land, and from 160 to 180 lbs. in the town. This is the longest waterworks conduit in Ontario, working under pressure.

The distribution pipes were laid with four feet six inches of covering, and generally in stiff, blue clay. The valves were manufactured by the Doherty Manufacturing Co., of Sarnia, and the hydrants by the Kerr Engine Co., of Walkerville. The hydrants have five-inch barrels, and are provided with a four-inch steamer nozzle, in addition to the two ordinary hose nozzles. The valve chambers are of hard brick laid in cement with heavy cast-iron manhole covers.

All valves are provided with extension spindles. Gate valves with valve boxes were placed on all the hydrant branches on the 12-inch mains, in order to permit the repairing of these hydrants without closing the valves on the 12-inch main. Two three-inch relief valves were placed on the system at a very low point where the pressure is greatest, also two of the same size under the water tower. These valves are set to relieve the mains when the pressure exceeds 120 lbs. The total length of pipe in conduit and distribution system is nearly 22 miles.

The water tower is of steel, 25 feet in diameter and 85 feet high. It rests upon a foundation of very heavy stone masonry laid in Portland cement mortar. The cylinder is well anchored to the masonry and has an ornamental balcony at the top, reached by a ladder. The tower contains about 257,700 Imperial gallons, or approximately 3,000 gallons per foot in height of the tower; when full it will give a pressure at the fire hydrants varying from 25 lbs. to 50 lbs., the average being about 30 lbs. To give domestic pressure in town, it will be necessary to keep the tower half filled at all times. The water in the lower half will be available for fire supply, but not for domestic purposes. By cutting off the tower, a good fire pressure can be given direct by pumping from the lake.

There are two pumping engines, one a compound "Duplex," and the other a compound "High Duty Fly Wheel." The first was manufactured by the Hughes Steam Pump Co., the second by the London Machine Tool Co., of London, Ontario. The duplex has steam cylinders, 14 inches and 26 inches in diameter, plungers 10 inches diameter, all with 18-inch stroke. The high duty engine has steam cylinders 13 inches and 26 inches diameter, water plungers 6½ inches diameter, with 32-inch stroke. It is speeded to make about 50 revolutions per minute. This engine is a very compact machine, the fly-wheel revolving on a shaft placed near the steam end. Each of these pumps has an easy capacity of 700 Imperial gallons per minute, or one million gallons per twenty-four hours, against a head of 200 lbs. to the square inch. One independent fly-wheel air pump, with feed pump attached, is operated in conjunction with a surface condenser, placed on the discharge main. A duplex feed pump supplies the water to the boilers. This pump can be used to empty the well, to pump into the conduit, or for hose service at the pumping station. Three 3-inch relief valves are placed in the engine room, with ample discharge pipes. Steam is supplied by two return tubular boilers 16 feet long, 62 inches in diameter each, with 68 tubes 3½ inches in diameter. These boilers were made and set by the Stevenson Boiler Works of Petrolea. Although both engines were in running order on January 1st, 1897, the contractors for machinery were not ready to test the pumping engines until February. The first test was made on February 4th and 5th, J. H. Killey, Esq., of Hamilton, representing the pump manufacturers. The fly-wheel pump was run ten consecutive hours under 200 lbs. water pressure, at the rate of 1,000,000 gallons per 24 hours, the coal consumption being 2,300 lbs. The duplex, in 10 hours, under the same pressure, and pumping at the same rate, consumed 4,400 lbs. This test gave a duty considerably below that guaranteed for the fly-wheel pump, but the duplex exceeded the guaranteed duty. On March 18th and 19th a second duty test was made of the fly-wheel engine in the presence of the manufacturers. During ten hours the coal consumed was 2,430 lbs.; ashes removed, 121 lbs.; water pumped, 462,338 imperial gallons; water pressure, 200 lbs.; suction lift, 14 feet; temperature of feed water, 109 F. The duty determined from the above is 98,570,000 foot lbs. per 100 lbs. of coal. The duty of the duplex engine was found to be 55,000,000 foot lbs.

The only defect in the Petrolea water supply system is that the pressure is not sufficient for fire protection. The town has, however, two fire engines, and all hydrants are provided with steamer nozzles. The engineer recommends that when the amount to be pumped daily increases to over 500,000 gallons, a pumping station should be erected near the water-tower, to be provided with two underwriter fire pumps of the same capacity as those at the lake pumping station. In this way water could be pumped out of the tower or the conduit line, and forced into the system under any pressure desired.

The quantity of water available is about 1,000,000 gallons per twenty-four hours. This quantity of water would supply a population of 10,000 people, allowing 100 gallons per day for each person. This is the quantity pumped in London, Brockville and Toronto, but less than that pumped in Sarnia, Port Huron, Windsor, Detroit, Cleveland, Buffalo and other lake cities and towns.

In spite of the recommendations of the engineer, that meters should be placed on all the services, they were only placed upon the services of the large consumers. As the original plans of the system were prepared with the idea of using meters all round, it will probably not be found adequate if the small consumers are allowed to waste the water. This matter, however, can probably be adjusted when the difficulty arises.

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The Farmers' Hedge and Wire Fence Company of Ottawa, Limited, has received an Ontario charter. Capital, $25,000. The incorporators are: J. Bright, Myrtle, Ont.; J. Vipond, Brooklin, Ont.; R. R. Mowbray, Kinsale, Ont.; E. E. Cooper, East Whitby, Ont.; J. D. Howden, Whitby, Ont.

## THE GREAT LAKES AS A SENSITIVE BAROMETER.

BY F. NAPIER DENISON, METEOROLOGICAL SERVICE OF CANADA.

*Concluded from last issue.*

From a careful study of the subject, with the assistance of the foregoing tabulations and records, the following points have been deduced:

(1) That when the lake record is least disturbed, so is the barometric trace.

(2) When the lake undulations become large and rapid, so do the atmospheric waves as recorded upon the barograph.

(3) There is a marked correspondence between the time intervals of these undulations as recorded by both instruments, the larger waves averaging 20 minutes, and the smaller ones 10 minutes.

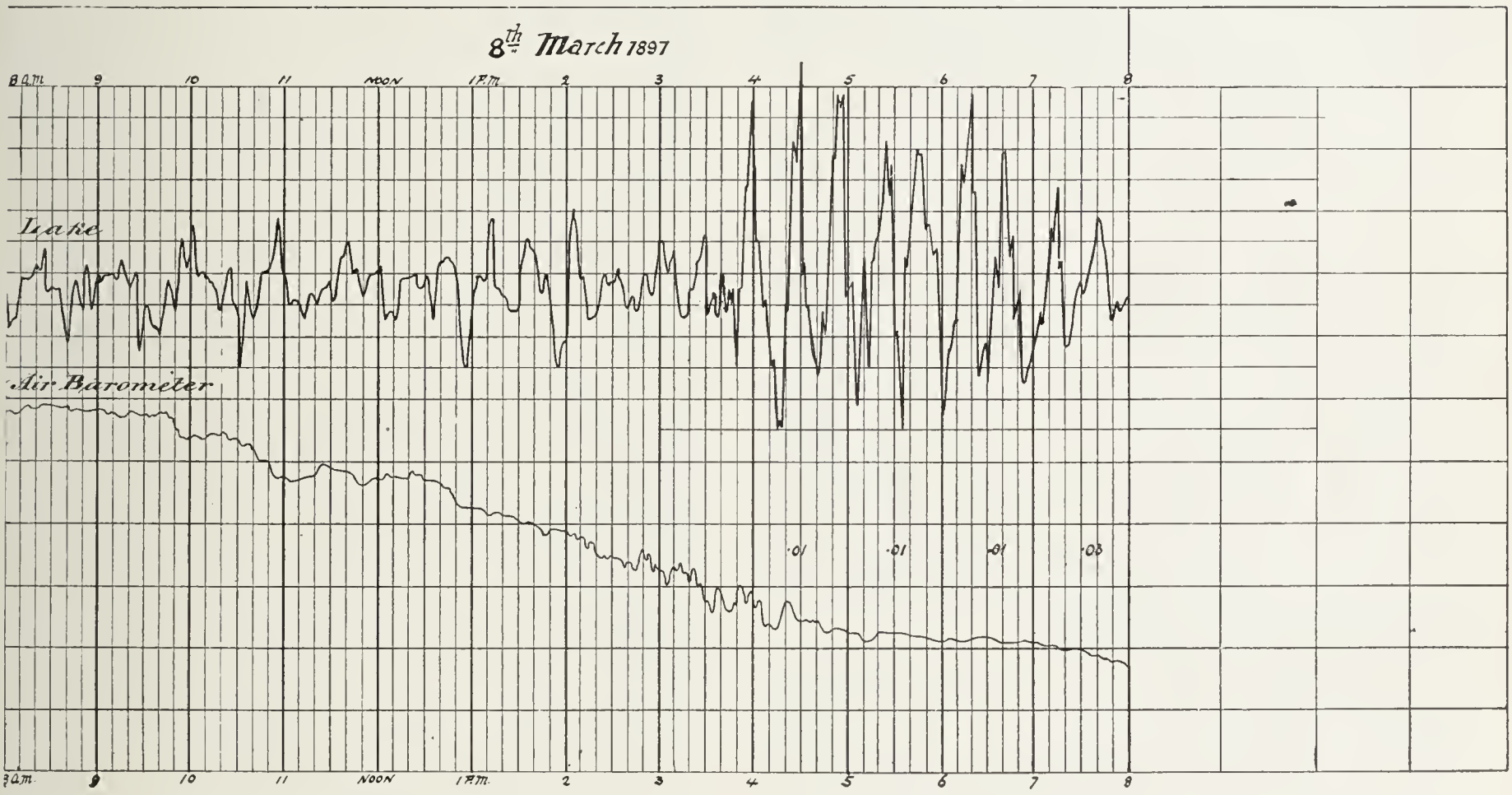
(4) That the lake level is never stationary; the smallest movements recorded for twelve consecutive hours was $\frac{1}{2}$ to 1 inch, when the barograph trace was also very quiet.

(5) That the longitudinal and transverse "seiches" are due to great differences of atmospheric pressure between the extremities of the lake, which are doubtless augmented when the gale strikes the water's surface. These "seiches" consequently appear shortly before, during, and for several days after the passage of some severe storms. The lake trace before us clearly shows this movement, and the following chart the position of the barometric gradient at the time of this record. From a limited number of observations the time interval of these "seiches" appears to be four hours and 49 minutes, and 45 minutes respectively. Should the isobars lie parallel with the length of the lake during the passage of a storm, the "seiche" movements become almost imperceptible. (The quiet traces of both barograph and lake instrument for the 27th February last, bear this out). This may explain why little or no undulations were remarked by Professor Forel, upon the Swiss Lakes, on certain days, although the wind was strong.

(6) The rapid heaping up of the water at one end of the lake, which is also due to great differences of atmospheric pressure between its extremities, in conjunction with the action of the wind, sets up powerful currents at both top and bottom of our lakes, which although of great sanitary benefit, particularly to the fish, cause much inconvenience and often loss of property to the fishermen; for after such disturbances, their nets, if set at right angles to the length of the lake, often drag their anchors some distance, and when brought to the surface are found to be filled with debris from the bottom of the lake. Such rapid changes of water level are invariably followed by the "seiches" or movements of oscillation of the whole lake's surface.

(7) That the smaller undulations are due to the direct action of the atmospheric waves or billows as they move over the surface of the lake, tending to form minute undulations upon the surface, corresponding in length to these billows, and as they move further into the bay, becoming magnified as they reach narrower and shallower portions, until finally they assume the proportions recorded upon the instrument.

(8) That these lake undulations become rapid and of great amplitude during fine weather, and a rising or stationary barometer when an important anti-cyclone is central over the lake region, and a pronounced cyclonic area is developing over the Southern States. This clearly




demonstrates the existence of great atmospheric waves, set up along the boundary surfaces of the upper and lower strata, caused by the upper portion of the lower air stratum, not being retarded by friction from contact with the earth, and of greater specific gravity than that to the south of it, beginning to move towards the region of lighter air, viz., in a southerly direction. The barometric gradient being small, the movement is slow, but in an opposite direction to the upper stratum, which is less dense and rapidly moving polewards.

(9) The falsely termed "tidal waves" encountered upon the lakes, especially upon Lake Erie, are due to large and rapid atmospheric changes, so often noticeable upon the barograph preceding or during thunderstorm conditions. The above is a fair illustration of the smaller "waves" as shown upon the Humber instrument for the 8th of March last. Here you will observe that both barometric and lake traces are decidedly disturbed until 2.45 p.m., when several abnormal undulations appear upon the barograph, followed shortly afterwards by correspondingly large lake undulations, greatest amplitude $11\frac{1}{2}$ inches in 15 minutes. You will also notice the marked 10 minute intervals be-

tween the smaller waves or "notches," as Professor Darwin would call them, upon the larger undulations. During this day thunderstorms were general near Lake Erie, while in the vicinity of Toronto there were only light showers.

(10) The larger lake undulations may account for the existence of the greater waves so frequently encountered by fishermen and sailors at apparently regular intervals. These are often termed "the three sisters" or "sister waves," as they usually appear in threes, the centre one being the largest. The central wave appears to coincide with the crest of such an undulation.

Before concluding permit me briefly to apply this study to the ocean tidal records as a probable means of accounting for what are termed "secondary undulations." From a careful study of certain St. John, N.B., and Halifax, N.S., tidal curves, furnished through the kindness of W. Bell Dawson, director of our tidal service, in conjunction with the synoptic weather charts, similar results to those upon the lakes were obtained.* These secondary undulations become most pronounced during fine anticyclonic weather, preceding by many hours the advent of approaching storms from the south and south-west. On the other hand the traces become quite quiet when the pressure is increasing to the westward of these stations, which is usually a precursor of fine settled weather.

These undulations are not due to "seiches," or movements of oscillation, which can only apply to enclosed bodies of water, but to the direct action of atmospheric waves or billows. These tend to form minute undulations upon the surface of the water at the entrance to bays, etc., which, as previously stated, become greatly magnified at the narrower and shallower ends of these arms of the sea. These secondary undulations exist throughout the world at all tidal stations, situated as stated above. They are graphically shown upon some of the tidal diagrams which form part of Admiral Wharton's report for the Royal Society upon the "Krakatoa Seismic Sea Waves"; also by Major Baird and others. It is interesting to note the marked regular and continuous undulations at Honolulu, which, if more thoroughly studied, may prove to be due to the influence of the North-east trades.

Finally, permit me to draw a few conclusions in connection with what has been brought before you. Modern meteorologists realize the necessity for a better knowledge of the upper atmosphere as a means of improving our present methods of weather forecasting, and have already done much through the use of kites, balloons, and cloud observations. May we not add the study of atmospheric undulations, as shown upon the lake and sensitive barograph records? The two former means are dependent upon certain atmospheric conditions, while the study of the clouds may often be confined to the lowest stratum, and at other times the sky may be quite clear; whereas the latter can be studied continuously, during all types of weather, by stationary instruments at the bottom of this ocean of air. Since these undulations occur upon all waters, would it not be of great scientific and commercial value not only to increase the number of these instruments upon the great lakes, but in place of eliminating these movements when tabulating ocean tidal records, to magnify their amplitude and study them in conjunction with the corresponding synoptic weather charts? Should the theory upon which the foregoing suggestions are based prove correct, such observations would be especially useful along a western seaboard, such as that of Great Britain, or our own British Columbian coast, indicating the existence or approach of ocean storms many hours previous to a fall in barometer at these stations. In conclusion may we not look forward to a day not far distant, when the ordinary mercurial barometer will be superseded by more sensitive self-recording instruments, and when the study of atmospheric waves will have become universal? Then will the forecast official be supplied, not merely with the actual barometer readings now furnished by the telegraph stations throughout his country, but by a special cypher code, with the undulatory condition of the atmosphere at these stations; and with such an increase of data at his disposal, who can fix a limit to the possibilities of weather prediction in the future?

*A probable solution of the secondary undulations found upon Self-recording Tide Gauges. Proceedings of the Canadian Institute, 1897.

*For* THE CANADIAN ENGINEER.

## THE ADVANTAGES OF THE SEPARATE SEWAGE SYSTEM.

BY W. M. WATSON, TORONTO.

The celebrated scientist, Ward, said that when arranging a system of drains and sewers, the rain water should be conveyed to some stream and the sewage to the soil, and there is sound logic in his remarks. It is of more importance to have two sets of drains, one to carry off sewage only, and another set to carry off rain water and the waters collected from springs and clean land, than many persons appear to suppose. Where the two-set method is installed, it will be found to be of incalculable advantage to the preservation of the public health.

If we take Toronto, which uses the combined system of drainage, for an example, we note that considerable claims are very often put in for damages done to property, on account of sewage and sewage deposits being forced back through the sewers into cellars and basements, and the damage claimed on this account is only a small percentage of the real damage done by the sewage being forced back on to private property during rain storms. Then there are thousands of street gullies, with large bags or pockets, which catch and retain the manurial and vegetable deposits washed off the street, which lie motionless, and by so doing set up fermentation and putrefaction, causing foul, unhealthy smells. These also we find to be periodically emptied of the foul matter right under the nose of the pedestrians. The cost of these trapped gullies when installed, and the periodical cleaning, is a large amount, and is almost sufficient to pay the expense of laying down a simple, shallow and inexpensive system of storm and rain water sewers.

There is nothing in connection with sanitary appliances that can do so much injury to the health of the house occupants as the sewage and the sediment being forced back out of the drain into the basement after putrefaction has set in, and I believe many of the poorest people live unhealthy lives and die of disease because of the practice of mixing sewage and storm water in one sewer.

It is a dangerous practice to put in sewers too large for the ordinary flow, because when that is the case, the flow is indolent and sluggish and moves as it pleases, taking a rest occasionally, and allowing the poisonous solids which it contains to be deposited in the bed of the channel, making the conduit into a settling tank, in fact upsetting every arrangement and duty that the sewers were intended to perform. Water is used to clean and to carry or float away filth or dirt, and it is avoiding its duty if it drops or lets go the solids which it is intended to carry away before the stream reaches the final outfall. The solids which are deposited, silt up the drains, reducing the size; they heat, ferment and putrefy, and manufacture

a dangerous and poisonous gas in large quantities, which is discharged through the ventilation-grates, contaminating the atmosphere, and it also presses through the seals of the gully and other traps. If a town's sewers are constructed so as to be capable of handling both sewage and rainstorm water, then they must be 75 per cent. too large for the quantity of straight sewage discharged. The rainstorms will only average about one hour per week, which leaves 167 hours a week for the sewers to act as a chamber for the generating of dangerous gases from putrid matters.

It is impossible to tell what size of drain or conduit will be necessary to cope with the waters discharged by a rainstorm, and if the heaviest rainfalls are provided for by the combined system, large expensive pipes must be laid at a great depth, necessary to collect the domestic sewage and trade refuse as well, while by the separate system large volumes of water which only fall probably six times in a year, could be easily conducted to the proper outfall by surface or shallow inexpensive channels, and by the natural water-courses. On the other hand it is easy to compute the quantity of flow of sewage, for it is very regular and only changes in quantity during the night, Sundays, and holidays ; there is seldom more than 15 gallons of domestic sewage discharged per head per day from water closets, baths, wash basins and sinks. The average trade refuse can be secured by reading the water meters, telling the amount of water used by each manufacturer or firm, and an estimate may be taken of the discharge from public baths, stables, or any other unusual sewage a town may have to handle. Thus a reasonably close figure can be got that will answer to give the size of pipes for each district and the main trunk sewer, and the quantity discharged will usually vary so very little that a small margin only in the size allowed to carry the estimated quantity will be necessary to meet contingencies.

Drains laid down the proper size to carry the necessary quantity of flow will always be self-cleaning, if given a very moderate downward grade, and the sewage passed through them will keep continually on the run, from the moment it enters the drain to the time it reaches the final outfall of the sewer ; therefore the sewage will be delivered at the outfall just as fresh as when it entered the drain, because it is impossible for moving sewage to ferment, decompose, or putrify, and no dangerous gases will be generated. The public will be protected from inhaling sewer gas by the adoption of the separate drain system if properly and intelligently arranged, independent of the traps and ventilating pipes, which are always introduced into good and efficient plumbing. A drain is greatly to be preferred that is continually getting scoured and cleaned by its own flow, than a sewer that is only scoured when a violent rain storm occurs, or when it is artificially flushed by an expensive and often complicated flushing machinery.

But there is a claim for separate drains over and above the before-mentioned advantages, viz., the disposal and the purification of the sewage before being allowed to enter the rivers or fresh water streams, ponds, lakes, etc. It is about as easy and inexpensive to purify a gallon of straight sewage as it is to clarify and purify a gallon of straight sewage adulterated by 75 per cent. of fresh water, and it is obvious that both the first cost of construction and the annual cost of management of any sewage works working under the separate system of drainage, must be considerably less than where the combined system is adopted. On account of the severity of the Canadian climate in winter, and the great heat in summer, water carriage of excrements will be almost in general use throughout the country, and it is the duty of all engineers to see that their bad effects be reduced to a minimum by confining them into as small a space as can be used for their transmission with quickness and safety to the place appointed for their filtration, purification, or discharge on to the land out of harm's way. About the only serious objection to the separate system of sewers is that the soot, dust and manure from the streets is washed into the storm water drains. Now these substances, if allowed to remain motionless after being soaked by water, will ferment and putrify. Should arrangements be made to bring this material into the sewers, then we must accept also the sand, grit, and other heavy substances from the surface of the roads, which soon choke up the gullies and channels. To overcome the difficulty of this objectionable matter passing into the surface or rain water sewers, the storm water might be forced through a large settling tank or reservoir immediately before it discharges into the natural watercourse of sufficient size to allow time for the solids to settle. But even if it is allowed to enter the stream without settling, the fluid will be as pure and free from poison as any of the other water flowing into the river from land and stagnant pools. The whole secret of healthy drainage is to keep the dangerous solids and ingredients contained in sewage moving briskly until they can expel with safety to the public health the dangerous gases they contain, and this can only be done by having a separate drain for the conveyance of sewage and trade refuse.

With regard to the expense, I may say that any experienced and intelligent engineer, with a proper amount of foresight, may install a separate system at about the same price as a combined system. Should the geographical position of any town be such that to introduce two separate systems of drains and sewers will increase the cost considerably, the advantages derived from having the two distinct systems to the preservation of the public health is many times more than the extra cost, and is a good return for the money spent. The dirt from the streets should not be allowed to lie in the pockets of the street gully traps. It is a serious menace to the health of the people. The dirt should pass along with the water and be kept in lively motion until it gets clear away from the people and to a place where the filth can be better handled, or where it will be purged of its dangerous elements. By the double or separate system there would be no need of street gullies with traps ; simple grates would answer.

## METAL IMPORTS FROM GREAT BRITAIN.

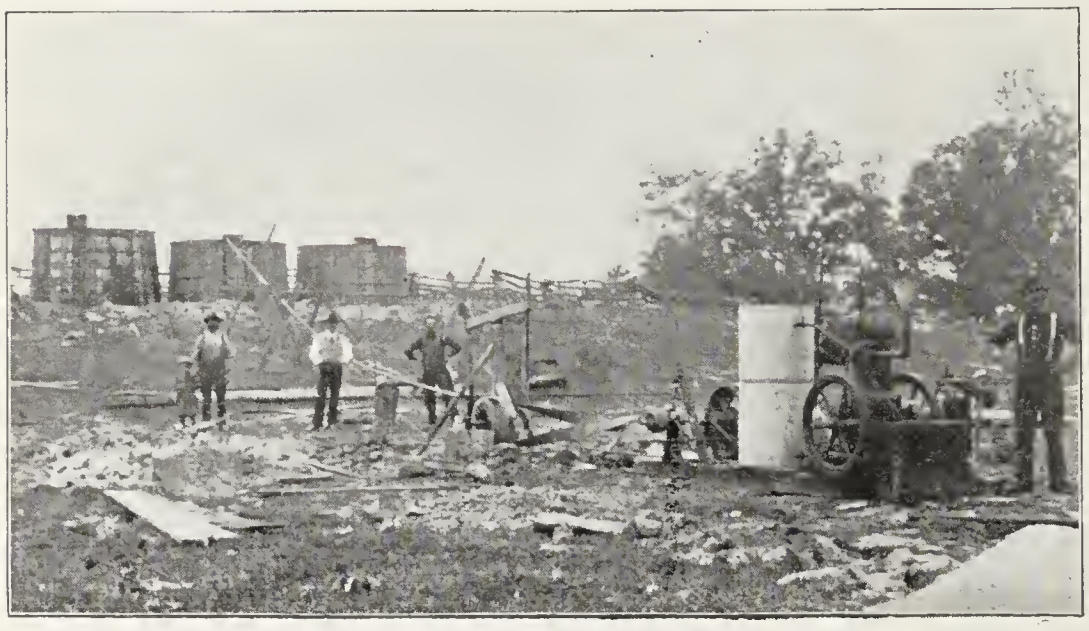
The following are the sterling values of the metal imports from Great Britain during September, 1896, 1897 and the nine months to September, 1896-1897.

| | Month of Sept., | | Nine months ending Sept., | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £6,195 | £7,041 | £48,867 | £50,672 |
| Pig iron | 3,838 | 1,240 | 21,230 | 5,298 |
| Bar, etc. | 1,101 | 977 | 12,626 | 7,572 |
| Railroad | 28,047 | 171 | 158,153 | 38,893 |
| Hoops, sheets, etc. | 4,354 | 13,792 | 35,758 | 55,954 |
| Galvanized sheets | 5,291 | 7,346 | 42,212 | 35,547 |
| Tin plates | 6,401 | 30,073 | 91,909 | 132,849 |
| Cast, wrought, etc., iron | 5,103 | 3,887 | 40,651 | 25,957 |
| Old (for re-manufacture) | 1,058 | 1,937 | 14,862 | 5,191 |
| Steel | 10,519 | 6,258 | 73,060 | 41,061 |
| Lead | 1,015 | 5,170 | 10,486 | 19,062 |
| Tin, unwrought | 419 | 2,403 | 11,716 | 13,814 |

THE Bridgewater Power Co., Bridgewater, N.S , which is putting in an electric plant, has recently purchased from S. Morgan Smith Co , York, Pa., a 30-inch McCormick turbine, mounted on horizonta shaft.

## A NEW OIL FIELD.

An oil well pumping outfit consisting of an "Imperial" gas engine, has been recently installed by the Cooper Machine Company, Limited, Toronto, in the new oil fields near Florence, Ont. This design of engine runs either on natural gas supplied from the well or the gasoline taken direct from the tanks. The illustration shows the entire outfit as arranged with countershafts for connection to the beam of the pump, and the tanks are shown to which the oil is pumped. When first started, the engine ran for some time on the surface flow of natural gas, and as this gave out the gasoline was used instead.



IMPERIAL GAS ENGINE PUMPING OIL WELL, FLORENCE, ONT.

The company is at present making a new design of a pump attachment, in which the slow speed needed for this work is obtained by gearing placed directly on the engine frame, and from which the connection is made without belting. The compactness of this rig recommends itself to interested parties, and the cost of fuel and attention is much less than with steam.

## AN AIR SHIP?

*Editor* CANADIAN ENGINEER.

SIR,—On the evening of September 11th, at about 10 o'clock, or perhaps a little later, the attention of myself and several others was directed to a star of unusual appearance by William Graham, Esq., It had two very beautifully colored lights, red and green, which could be noticed fairly well with the naked eye, but much better with the aid of a telescope. It seemed to be several miles away, and was moving towards the north-west with considerable speed, at an altitude of about twenty degrees when first seen. We supposed the colored lights were attached to a balloon, but this is mere conjecture. May it not have been a party of moonlight excursionists on a trip to the Klondike?

Yours truly,

WILLIAM J. PHOENIX,
Teacher.

Honora, Manitoulin Islands, Oct. 1st, 1897.

## AN AIR SHIP?

*Editor* CANADIAN ENGINEER.

SIR,—In answer to yours of the 22nd Sept., I beg to state when I first detected the light I thought it was the evening star, but it being very large, bright, and more condensed, caused me to observe it carefully, when I noticed it flickering and moving to the north-west. I called the attention of the household and neighbors to look at it. I got the glass, so as to draw it nearer for observation, when I detected the three lights, which seemed to blend through one another, as they were in a straight line from me. I did not see the balloon, it being too far away, and the moon was bright. It must have been about half a mile high, and seemed to keep the same elevation, as far as I observed it. In the distance it looked as if a person was carrying a lantern, as the light kept shading. It must have been the motion of the balloon which caused it. I notice by the clipping you sent me that the balloon was seen at Vancouver on the 13th August, and again on the 16th near Port Arthur, as mentioned in THE CANADIAN ENGINEER for September. Now it appeared here on the 11th September, and again I see by the *World* that it has made its appearance at the north of Russia on the 14th Sept. The wind was blowing here from the south-east when I saw the light, which carried it north-west. The next day it blew from the south-west, which would send the balloon north-east, and the following day it blew from the north-west, which would send it south-east if the wind was blowing from the same direction all over. If it is Andree's balloon, he is, instead of going to the north pole, travelling around the Arctic circle.

Yours truly,

WILLIAM GRAHAM.

We, the undersigned, certify that we saw the light on the 11th September, at about 10.30 o'clock p.m., crossing over to the north shore

ALLAN HOUSTON.
WM. F. GRAHAM,
MRS. WM. GRAHAM.
MISS ELLA GRAHAM.

Honora, Manitoulin Islands, Oct. 1st, 1897.

## SEWAGE DISPOSAL.

*Editor* CANADIAN ENGINEER:

SIR,—I have read with considerable interest Mr. Watson's paper on "Sewage Disposal" in the current number of your excellent journal, but I think Mr. Watson is under some misapprehension as to the action of my filter. The filtrate is never water-logged or immersed in water, as he appears to imagine, as the outlet is always open to the atmosphere, and the sewage to be filtered is held back by the finer surface layer, and passes from it in thin films over the coarser grains of the filtering material below, the interstices of which are kept continually filled with fresh air by means of the blower, which is driven either by power got from the sewage itself, or from the engine pumping the sewage, or mixing chemicals, where such is necessary, or by any other outside power; the power required being extremely small, about 1½ horse-power per million gallons filtered being sufficient.

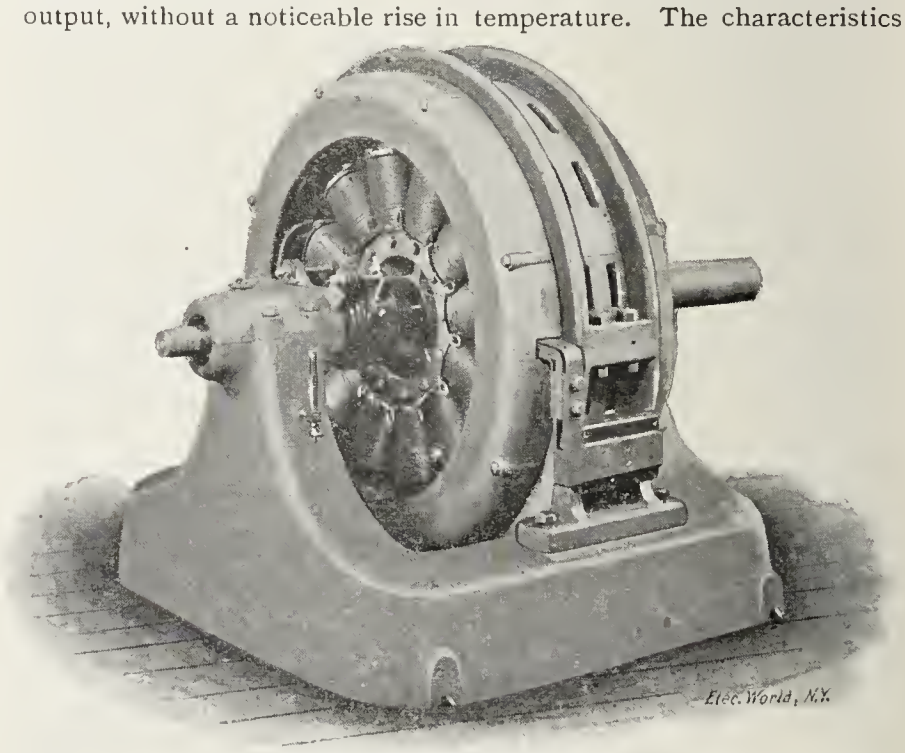
Yours faithfully,

SIDNEY R. LOWCOCK,
A.M. Inst. C.E., F.R. Met. Soc., etc.

35 Waterloo St., Birmingham, Eng.

## ELECTRICAL MACHINERY AT THE MERRITTON CARBIDE WORKS.

The Willson Carbide Works Company at Merritton, Ont., is probably the only enterprise engaged in the manufacture of carbide of calcium, which is turning out that much discussed product, daily, up to its full capacity, and at a profit. The electrical apparatus used in this plant is of the most interesting character, having been specially designed by the General Electric Company to suit the peculiar conditions under which the manufacture of carbide can be successfully carried on. The company has at present in operation four machines of 150 kilowatts capacity each, and has recently placed an order for two more of the same size, which will be in operation in the course of a couple of months. These generators are of the revolving field type, with stationary armatures, and are designed to run continuously twenty-four hours a day, at a load considerably in excess of the rated output, without a noticeable rise in temperature. The characteristics




REVOLVING FIELD TYPE GENERATOR.

of these machines are such as to enable them to supply a proper amount of current for a furnace at the proper voltage, no matter what the resistance conditions of the arc may be, and they may be short-circuited repeatedly, or even run on a short circuit without injury. The location of two of the power houses renders necessary a transmission at 1,000 volts, and in this case step-down transformers of the Niagara

type are used to reduce the current to the proper voltage for supplying the furnaces. Altogether, the detail and operation of this plant is most interesting, and its success in turning out carbide of calcium on a commercial basis is in marked contrast to the operation of several plants, on a much more ambitious scale, which have been established in the United States.

## AMERICAN STREET RAILWAY ASSOCIATION.

The 16th annual convention of the American Street Railway Association opened at Niagara Falls, N.Y., on the 19th ult. The attendance was very large, and the exhibits more numerous than at any previous convention. Among the Canadian members and visitors present were the following: Frederic Nicholls, president Brantford Street Railway, and general manager of the Canadian General Electric Co.; C. F. Armstrong, E. D. McCormick, and Geo. Watts, all of the Can. Gen. Electric Co.; Frank Badger, Montmorency Electric Co.; J. E. Brown, superintendent, and Mr. Bradley, foreman, Hull Electric Railway; W. A. Johnson, of the W. A. Johnson Electric Co., Toronto; Messrs. Griffiths, Wagner, and Fearman, of the Hamilton Electric Ry.; T. Watson, secretary, and C. K. Green, superintendent of the Hamilton Radial Electric Railway Co.; Wilfrid Phillips, manager Niagara Falls Park and River Ry.; Charles James, Storey Motor Co., Hamilton; A. J. Nelles, and Charles Myles, of the Hamilton, Grimsby and Beamsville Electric Ry.; H. Nicholl, of Kingston Electric Ry.; C. E. A. Carr, manager London Electric Ry., and others.

The president, Robt. McCulloch, announced that eleven street railways had sought membership just previous to the meeting. In his opening address the president spoke of the increasing use of Niagara's great power for electrical purposes, among them being important railway extensions. He praised the work of the Street Railway Accountants' Association, which had been formed in connection with the association.

The first paper was by P F. Sullivan, manager of the Lowell and Suburban Railway Co., Lowell, Mass., on "Municipal Ownership of Street Railways." He compared the American system of private company ownership with foreign and American municipal systems, and gave the opinions of prominent men. These opinions went to show that the weakness of municipal ownership was the great corruption that existed in city and town councils. American street railways also had a much greater mileage than European city systems, and the latter also made smaller profits.

In the discussion on this paper, Mr. Bean read a newspaper report stating that the recent convention of Mayors held at Columbus, O., endorsed municipal ownership. He stated that in some States the authorities could take over a road by paying for it, in other States they could not possess it till the franchise expired. In Michigan they had the power to parallel a road and so destroy it.

G. W. Knox, engineer of the Chicago City Ry. Co., read a paper on "Some of the difficulties in the construction and operation of Electric Street Railways." He thought many a road now in the hands of a receiver could be made to pay a dividend, if unnecessary extravagances were cut off. The first thing was to select a staff of operators who were interested in their work, from the head foreman down to the man who swept out the waiting-room. Engines and electrical machinery have reached such a state of efficiency that there is not so much chance of economizing there, but there is great room for saving in the purchase of supplies and the outlay for repairs. The unwary railway man has a great amount of experimental claptrap machinery inflicted on him which is apt to cost him dearly. The competition among makers of electrical machinery has led to the adoption of piece-work in its production, so that it has become cheap, but inefficient. In buying machinery, therefore, detailed specifications should be made out for every piece of apparatus, but to do this requires knowledge and discretion. The stock of supplies should be kept low, so as to avoid loss when new developments require a change of designs. An intelligent staff of motor-men is most important, and a commendable practice is to call the heads of departments together regularly for consultation.

In the afternoon a large number of delegates visited the big power-house, the Carborundum Co.'s works, and the extensive works of the Niagara Falls Power and Manufacturing Co., at which place the chief engineer, W. C. Johnson, gave an instructive account of the power development already accomplished and still to be carried out.

Charles Hewett, electrician of the Union Traction Co., of Philadelphia, read a paper on the "Application of the Storage Battery to Electric Traction." The application of the battery system direct to car or locomotive is more costly, and the expense of operating is greater than the trolley system. It is also less reliable, and is objectionable, owing to the gas given off. Although manufacturers have been working since 1880, they have not surmounted the difficulties caused by the great weight of the storage battery and its rapid deterioration. He was confident that the battery requires more power than a trolley car of same size and under same conditions, and requires a larger investment in machinery. Every battery has what may be termed a critical rate of discharge. From zero up to the critical rate the working E.M.F. remains practically constant, but for any particular battery there remains a rate of discharge which cannot be exceeded without useless waste of energy. As Sir David Salomon observes, "it takes power to get current through the battery, and it takes power to get the current out." These critical rates of charge and discharge appear partly due to the time required for the chemical reactions in the battery to take place. For an electric car the battery needs to have a large output for its weight and bulk. To get this it is necessary to increase the surface of active material and decrease the inactive supporting grid; consequently the apparatus becomes mechanically weak. The difficulty is to get the plates large enough to prevent exceeding the critical discharge rate, and at the same time light enough and small enough to be carried on a car. For the same reasons it is doubtful if the lead battery will ever be successful on a car. Great results are expected from experiments now being made in Chicago, but great results have been expected before, and he did not look for any essential improvement from these experiments. In some cities in Europe there is a proscribed area within which overhead lines are not allowed. To overcome this, the cars are provided with batteries large enough to propel them at a low speed for three or four miles to the point where the overhead line may be used. While the cars are completing the trip the batteries are charged from the overhead wire. This arrangement is only a make-shift, and the fact that the battery is only used on the section where it is compulsory, is of itself a proof that it is not the best. It is also significant that the commission appointed by the larger roads in England and Scotland to investigate the various methods of traction in vogue throughout Europe and America, have vetoed any form of battery car. A third phase of the battery-car system is the battery locomotive. Aside from special forms, such as the Heilman locomotive, the one most worthy of mention is the experiment on the New York Elevated Railway, in which the battery is connected in multiple with the line, and charges or discharges according to the demands of the train. When the demand of the motors is sufficient to lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method the extra weight of the battery has the certain advantage of giving additional adhesion to the rails. While not wishing to seem pessimistic, he did not think the outlook for the battery-car was bright, unless some combination of elements be discovered whose characteristics are entirely different from the lead battery. The application of the storage battery to the ends of long lines, was, however, a different matter. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this the battery is not subject to the great loss due to the fall of E.M.F. on discharge. Only a few such installations have been made, two of which are on the Isle of Man; one has been installed by the Anaconda Mining Co., at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made from any large city road for its suburban service, is the one installed by the Union Traction Company, of Philadelphia, Pa. The increase in the travel necessitated a large increase in the car service and length of line, which was extended to a point 11.2 miles from the power-house. The

drop in pressure over this long line made it impossible to run the requisite number of cars, as the speed of a trolley car is approximately in the direct ratio to the applied E.M.F. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 feet of 1,000,000 circular mils. cable, at a net cost for cables, without conduit, of $273,800, which would have been prohibitory. A station of 750-kw. capacity would have cost about $85 per horse power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate, and its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery, and building, was approximately $25,000; to which must be added the cost of a booster in the main power-house. In this installation, however, they simply adapted a 300-kw. generator to this service, so that they were put to but little extra expense in the power-house for adapting it to booster purposes. If we however, deduct $33,000, the cost of the battery and booster, from $85,000, the cost of a station, the difference in the first cost is $52,000 in favor of the battery. In addition to this, they were put to an expense of a little over $13,000 for changes in the cable. As to cost of operation: During May, 1897, the battery-house delivered to the line 103,053 kw. hours. Estimating the cost of local generation of this power at 1½ cents per kw. hour, and adding interest, depreciation, etc., the cost by local generation method for one month is $2,454. The actual cost by the battery method, including depreciation etc., and central station power at 0.6 cent. per kw. hour was $1,100, showing a saving of $1,300 per month by the use of the battery.

The application of the battery to the power-house has not become very generally appreciated, and but few installations have been made. As its advantages become better known, the practice will become more general. The wide fluctuations in load in railway power-houses are now well known. The average daily load varies from 50 per cent. of the maximum in small stations to 70 per cent. of the maximum in the largest stations. From a very large number of observations in all parts of the country he finds that in the majority of stations the average load is very close to two-thirds of the maximum load. Now, the maximum economy of the steam engine exists for a very small range of load, and on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 45 pounds of coal per kw. hour. With badly regulated engines, and especially with water-power plants, the changes in load are accompanied by variations in speed, and consequently in voltage. These troubles may be entirely corrected by installing a battery. The battery in this case becomes distinctly a load regulator. In potential regulation a comparatively small battery is necessary, since by changing the potential of booster from time to time during the day the charge and discharge can be kept very low. In the case described, a battery rated at 120 amperes has successfully regulated a total output of 1,400 amperes. For load regulation, however, the battery should have a capacity equal to one-third the maximum output of the station. The average load of the station may then be made the maximum load of the engines, the battery taking care of the fluctuations. As in the previous case, there are no physical limitations to be placed on the size of the plates to be used, and the charge and discharge may be kept well within the normal rate. Under such conditions the efficiency of the battery is high—85 to 90 per cent.—and the deterioration very low. In most cases no additional labor will be required. The writer was of opinion that all small stations could be operated better by batteries.

The next paper was by Maurice Hooper, electrician of the Lynn and Boston Railway, of Lynn, Mass., on "The Use of Multiphase Current Transmission for Ordinary Street Railways," which we hope to refer to later on.

Geo. H. Davis, superintendent of the Canal and Clariborne Railway Co., of New Orleans, read a paper on the "Discipline of Employees," in which he held that both good and bad service should be noticed, the former by a complimentary letter, and at times when traffic is very heavy, the employees should receive a share of the increased earnings. Before any man is discharged he should be given a chance to defend himself. A fixed plan of promotions should be adopted.

A committee was appointed with instructions to draw up next year a code of rules for motormen.

Col. Heft, of the New York, New Haven & Hartford railroad, gave an account of their experiences with the third-rail principle construction. The third-rail system had cost them about $3,000 per mile, or about half the cost of overhead construction.

W. J. Heild read a paper on "The Best Method of Settling Claims for Accidents." A sensible man should be at the head of this department, and injured parties should be examined by the company's surgeon, and offers of assistance made. It was very unwise to antagonize anyone who might bring in a claim for damages. Upon settlement a release in full should be taken before witnesses.

A. E. Lang, of Toledo, O., was elected president; W. Caryl Ely, of Niagara Falls, vice-president; and T. C. Penington, Chicago, secretary-treasurer. Boston was chosen as the next place of meeting.

The Canadian Niagara Falls Park and River Railway, the Great Gorge Route and Frontier Railroad, and the Buffalo Railway Co. gave the delegates the freedom of their roads, which was much appreciated.

## KNAPP'S ROLLER BOAT.

Last month the roller boat, designed by F. A. Knapp, and referred to in previous numbers, was towed out into Toronto Bay, and the engines started. The internal platform on which the engines were fixed swayed slightly at first, but was steady when the boat got into motion. Mr. Knapp claimed that the boat made six miles per hour, but a gentleman who accompanied the craft in a skiff measured the speed, and found it to be three miles per hour. There was not a breath of air moving, so that the experiment cannot be said to demonstrate anything as to the seaworthiness of such a boat. After the first trial the flanges, or paddles, were extended, and a second trial—also in a dead calm—resulted in slightly better speed. Mr. Knapp has yet to convince practical seamen and marine engineers how he will obtain power to run against a gale, how he will settle the question of anchoring in rough weather, and enter and leave a port, and how he will stow and discharge his cargo. He has shown that in a calm his boat will roll; he has yet to show that it will navigate.

## THE ELECTRICAL TREATMENT OF IRON ORES.*

The extraction of iron ore magnetically, where the conditions were at all favorable, has been a process long known in the mechanical arts, and not a little of the early study and advance in magnetism was due to the desire to perfect apparatus which should so simplify and cheapen the production that even the leanest deposits of magnetic ore could be worked profitably. Patents dealing with the subject run back through many years, and the litigation of magnetic ore separation has been a long one. Perhaps the most interesting chapter of history in this field, for the public in general, is that due to Thomas A. Edison, who may be said to have turned his energies seriously toward the subject as soon as he had satisfied himself that the foundations were firmly laid for the new art of incandescent lighting. No one thing at any time ever fully occupies the ceaseless activities of that great inventor, but it may be questioned whether during the last five years any other problems have equalled in interest to him those connected with magnetic separation. Hitherto no details of consequence have been given out, but he and his associates have been spending money freely to acquire the workable ore deposits, then to treat them on a large scale of technical and commercial success, and lastly, to market the various products that result from the treatment. The appearance of the present article marks, therefore, the reaching by Mr. Edison of a stage at which he sees the goal of his hopes well in view and touch; and while the data and illustrations we are here permitted to give cannot be taken as final for one whose motto is forever, "Improve," they must be broadly characterized as of a most interesting character, and as revealing the furthest attainment of human effort in the direction of cheapening iron. It should be noted incidentally that in regard to some points, Mr.

*Reprinted from the *Electrical Engineer*, New York, Oct. 28th, 1897.

Edison prefers for the present not to give out all the information desired.

In the mountains of middle Jersey Mr. Edison is now doing his chief work in magnetic separation, but other plants are projected. The veins near the works at the place now called Edison, not far from Lake Hopatcong, are known by careful tests to contain over 200,000,000 tons of iron rock, suitable for crushing. The rock is magnetite in a feldspar gangue, containing about 25 per cent. of oxide of iron, and it can be crushed with ease. The enterprise under prevailing conditions is rendered possible largely by its location, other sources of Bessemer ore being so remote—Lake Superior, 1,200 miles; Cuba, 1,600; Spain, 3,800, or Africa, 4,300. The investment between the Lake Superior mines and the furnaces in the Pittsburg district, consisting of railroads, double sets of ore docks, steamships, etc., as compared with the investment between the mines at Edison and the Eastern furnaces, is as 2.2 to 1.

Returning to the enterprise itself, we may state that the principal buildings are the power-house, crushing plant, stock-house No. 1, refining plant, stock-house No. 2, sand-house, machine shop, and store-room, mixer plant, briquette plant, furnace plant, and stock-house No. 3. Besides these there are 36 smaller buildings, including offices, blacksmith's and carpenter's shops, oil and residence buildings. The power plant includes 7 engines, of 1,800 h.p.; one compound triple expansion engine is that which ran a portion of the machinery department at the French Exposition at Paris in 1889. In the electrical equipment are 10 dynamos and 2 motors. Lighting current is generated for 40 arcs and 700 incandescents, over two and one-half miles of circuit. In the new dynamo room that Mr. Edison has taken much pleasure in laying out, is a cement switchboard, with iron frame, made on the spot, in a few days, for a few dollars. It is not so unornamental as it sounds, by any means.

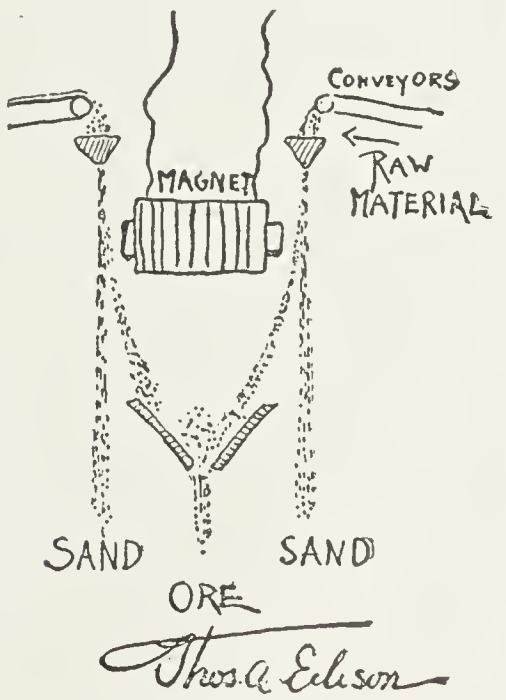
Around the property are some three miles of narrow gauge railroad track, with three locomotives, the trackage varying in length and distribution with the amount of working being done on the different veins. From first to last there is an amazing absence of human labor. All told, including night shifts and day, there are about 250 men around the place. But for the fact that from the moment when the vein is stripped, to the instant when the Edison ore briquette drops on to the outgoing car, no single hand is laid on the material under treatment, there would be two or three able-bodied regiments of laborers of all styles busily engaged on the property. At the outer extremities of these railroad tracks, work two huge excavators, one weighing 60 tons, the other 92, a third one being about to start up. Either of these will bite up four or five tons of rock every minute from the vein, and keep on doing it all through the day. Dynamite is used to get the strata in an amiable and yielding mood, but Mr. Edison considers it infinitely cheaper to do the real smashing up at the breakers, so that the rock is brought away in literal boulders. As each train of double-skip cars is freighted, it is hauled off to the crushing plant, where two 7-ton electric cranes, sturdy and effective, and one of them with earmarks of home production, lift it up and drop it into the jaws of the giant crushers, the skips being then lowered back to the trucks for the next trip. Four thousand tons of crude ore a day is fair working.

The big rolls, studded with knobs, that are a combination of claw and fist, weigh some 130 tons, of which 70 tons is in the moving parts. They are driven by a friction belt, so lightly adjusted that in starting up from a state of rest, a touch with a lever is needed for the initial impetus, when the belt and friction bring them up to full speed, with a circumferential velocity of a mile per minute. As the rock disappears between them they slow down, and the friction belt again speeds them up for the next load. The faces of the rolls are 16 inches apart, so that a 15-inch lump could go through, but nothing larger than that retains its identity.

The ore then goes to a pair of intermediate rolls, which are directly under the first, and of the same type, driven in the same way, except at a higher peripheral speed. These rolls are about 7½ inches apart. The ore passes to elevator No. 1 and is delivered to the top of the building. It then goes through three pairs of rolls 36 inches in diameter, and is reduced to particles of one-half inches, proceeding en route through a dryer which gets rid of all the ice, or snow, or moisture, and is then taken by conveyer and elevator to stock-house No. 1. The rolls are fitted with a most ingenious device, which effectively eliminates the possibility of breakage, and there is no piece of crushing machinery, pair of gears, pulley, or other moving mechanism in the entire plant, from one end to the other, that is not in some part of it connected up by "breaking pins." These in their respective sizes will just carry the work at full load. If anything goes wrong in the way of strains, or if nuts, bolts, or any foreign substances get into the machine, the pins break, and no damage is done to the machinery itself. The idea is really a clever adaptation of the safety fuse principle. The pins are sized down to one-thousandth of an inch. To the employment of this simple device is owing the fact that in all the experimental work that has been done in preparation, as well as in the actual running of the plant, the total breakage has amounted to only a few hundred dollars.

After having been delivered to the stock-house the material is taken continuously, or later, by a conveyor with iron buckets, which runs at a slow speed and has a large capacity, and is delivered at the refining plant, directly over the "three-high" rolls for further reduction. When Mr. Edison first started the work he began experimenting with ordinary Cornish crushing rolls. After making several hundred experiments as to speeds, pressures, and feeds of various numbers of tons per hour, he determined the fact that the friction of the machine was about 82 per cent. of the power applied, leaving only 18 per cent. for the actual work of crushing. He then set to work to improve the ordinary rolls, with the result of evolving "three high" rolls. which have more than reversed the former conditions, the friction of these machines being about 16 per cent., leaving 84 per cent. of the power applied to do the work. In the old type of Cornish roll it was found that the friction was largely due to a moving shaft running against a fixed bearing under great pressures; in the new machines it is so arranged that the bearing moves at the same rate of speed as the shaft, permitting great pressures with a minimum friction. The moving bearings are made up of wire ropes.

The ore is next carried to the 14-mesh screens, the portion too large to pass being returned for recrushing, while the remainder goes on to the first set of magnets. The magnetic building is 95 feet high, 28 feet wide, and 140 feet long, and will handle 300 tons of crushed rock per hour. The magnets have about one mile of face, and the ore is caused to fall in such wise and at such a rate before them, but not touching them, that the iron is deflected, while the gangue or tailing goes right straight down. The magnets are of special form,




6 feet long and 12 inches wide, in banks of 3 high, their power increasing from the top one to the lowest. At the start the weakest magnet at the top frees the purest particles, and the second takes care of others; but the third catches those to which rock adheres, and will extract particles of which only one-eighth is iron. This batch of material goes back for another crushing, so that everything is subjected to an equality of refinement. We are now in sight of the real "concentrates," which are conveyed to the dryer No. 2 for drying again, and are then delivered to the 50-mesh screens. Whatever is fine enough goes through to the 8-inch magnets, and the remainder goes back for re-crushing. Below the 8-inch magnets the dust is blown out of the particles mechanically, and they go to the 4-inch magnets for final cleansing and separation. Current at determined voltage and amperage is delivered to the magnets from special dynamos through a special regulating and indicating switchboard. Obviously at each step the percentage

of feld-spar, phosphorus, etc., is less and less until in the final concentrates the percentage of oxide is from 91 to 93 per cent. As was intimated at the outset, the tailings will be 75 per cent. of the rock taken from the veins or ore, so that every four tons of crude, raw, low-grade ore will have yielded, roughly, one ton of high-grade concentrate, and three tons of sand, the latter having also its value in various ways, to be referred to later. The sand is transported to the rear of the works, and there stored in a miniature mountain, from which it can be easily loaded into cars and carried away. The concentrate in its fine, powdery state, is delivered into the stock-house No. 2, holding 5,000 tons, or stock-house No. 3, which has a capacity of 30,000 tons. The object of these numerous stock-houses is to allow any part of the works to go on for some time, despite interruption at other points; and thus, so to speak, the "load line" of output can be kept level.

From the stock-houses the concentrates are delivered to another building and into the mixers, long, cylindrical machines equipped with paddles, called "spreaders" and "smoothers." To the mixers a binding material of special nature is fed at one end, and after being churned up, the new coherent, pasty ore is taken by conveyors to the briquetting machines in the same building. At these machines it is compressed into briquettes weighing a little over one pound, 1¼ inches thick by 3 inches in diameter. There are now 30 of these machines in use. In the briquetting machine the ore receives pressures running up to thousands of pounds on the whole diameter. The briquettes are then dropped by the machine on to conveyer bands, which transport them to the furnaces in which they are dried. They remain in the furnace about one hour, and are subjected, as they travel very slowly, to a temperature of not less than 600 deg. F. They are then carried away by the conveyer and loaded into the cars waiting on the railroad outside. The economy of labor is still so elaborated that it requires but one man to load the briquettes, distribute them in the cars, and put the cars in position, the whole thing being done by machinery actuated by the pressure of two levers. The operator can load five cars without having to change his position.

The earlier briquettes worried Mr. Edison by the amount of moisture they absorbed. Then the concentrates did not work nicely in the furnaces, but inclined to blow out, owing to the high pressure of blast, and in other ways they interfered with the regular working of the furnaces. The difficulties to overcome were serious. Very little binding material was an essential. The first cost of such material must be very low. The briquettes must be prevented from absorbing moisture, but at the same time must be left porous to the gases in the blast furnace. Finally, the briquette must be hard at ordinary temperatures, so that it could be shipped like coal, and it must not disintegrate immediately under the fierce heat in the blast furnace. To accomplish all the above, Mr. Edison tried thousands of experiments before he found the correct binding material. The briquette now made will absorb 26 per cent. of its own volume of alcohol, but repels water absolutely.

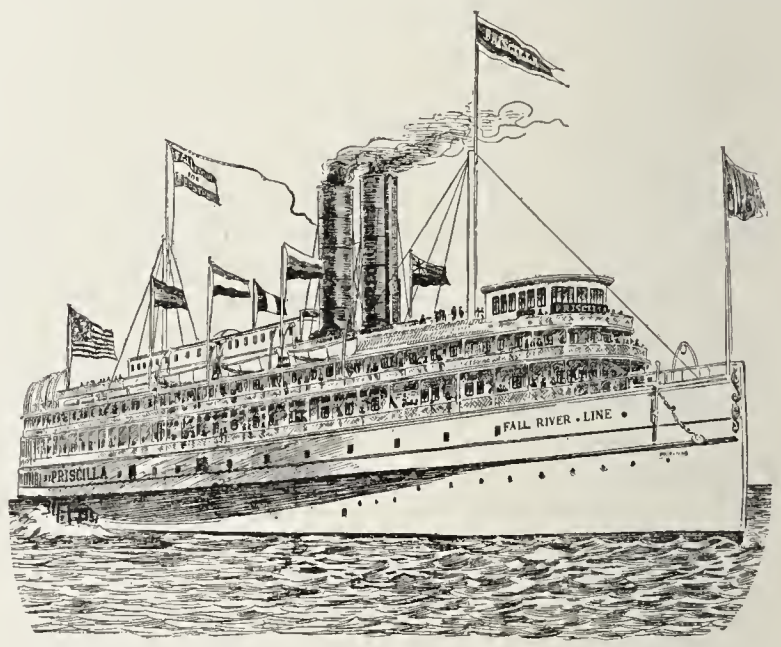
As to results in the furnace it has been found that by the use of the briquettes the output per ton of pig iron per day can be increased from 35 to 50 per cent. over the ordinary mixtures of ores now being used, with a lesser consumption of limestone and fuel. Besides, as already pointed out, this ore has but 100 miles to travel to its destination, and seems not unlikely to assume vast importance in helping to maintain the prosperity of the iron-producing districts of the East, to say nothing of its effect on the export of iron, now beginning to assume such large proportions.

Many features of ingenious time-saving, labor-saving, material-saving about the works could be dwelt on, for Mr. Edison, while optimistic and enthusiastic, is always keen after the shaving of each mill from the cost. Of new contrivances to get around difficulties there are a great number, some relating to the dust, for it is evident that in such ore-milling works the particles fly about thickly. The dust was for a long time a nuisance in the bearings of the elevators and conveyors, but at last Mr. Edison came to the conclusion that as it could not be got rid of he would turn the bane into an antidote. He now has a form of oil feed and bearing in which, after the oil is fed, the bearing is dusted over so as to prevent the oil running away. Dust from the surrounding air soon cakes on additionally, but as soon as the film grows too thick and heavy it is automatically flicked off, when the oil feeds again. The dust skin or shell reforms, and the same cycle is repeated indefinitely. The bearings are thoroughly protected, and once a month is often enough for refilling the oil cups.

The manufactured sand is sharp and crystalline, and, of course, remarkably even as to quality, besides being free from deleterious salts, etc. Natural sand, moreover, is rounded. The Edison sand has special qualities, and is a valuable element is the best cement or mortar. It is just the thing for the sand-box of the trolley car or the locomotive, not absorbing moisture. It is already in demand for various industrial purposes, and being a by-product in enormous quantities, its price is very low.

## THE RICHELIEU AND ONTARIO NAVIGATION COMPANY

The Richelieu and Ontario Navigation Co. is in possession of one of the most attractive tourist routes in the world, and in order to bring large numbers of travellers to its boats it has been decided to equip the fleet with steamers which will compare favorably with any fresh-water vessels afloat. The type of construction chosen is that of the famous Fall River steamers, which are known where tourists meet together as models of all that passenger boats should be. The "Priscilla," of the Fall River fleet, is shown in the accompanying illustration, as giving a very fair idea of what the two new boats to be built by the Bertram Engine Works Co., Limited, Toronto, will be like. The dimensions are: Length over all, 277 feet; depth, 14 feet. The structural hull work is of open hearth steel. Each steamer will contain 140 state-rooms, and in addition, a large sleeping cabin below deck aft, where the dining-room generally is placed on earlier steamboat designs. The




full passenger sleeping accommodation on board is 428, the number of passengers allowed by law being over 1,500. A feature of the design is the placing of the dining saloon on the upper deck, forward, giving light, air, and an opportunity even at meals, for an unobstructed view of points of interest along the route. The tables are arranged for seating at one time 112. The chief engineer of the Bertram Engine Works Co., Arendt Angstrom, who has been with them for the last five years, is well able to build the steamers. He is a native of Stockholm, Sweden, and a graduate of the French Government College for Naval Construction. Before coming to Toronto he was for a number of years chief engineer of the Cleveland Ship-Building Company, and previous to that time was consulting engineer with the Fall River line.

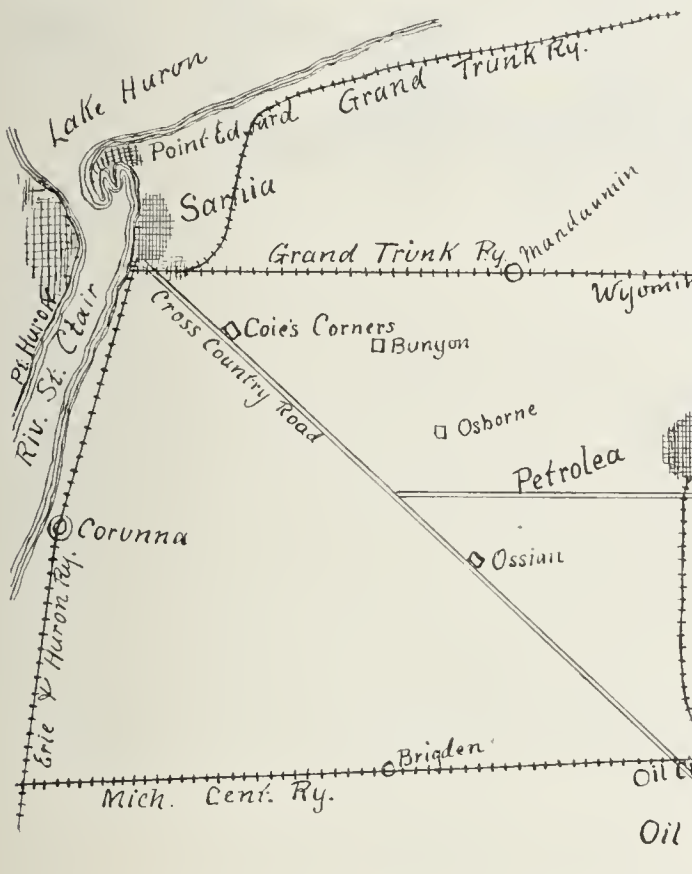
## ANSWERS TO CORRESPONDENTS.

J.M., Ashcroft, B.C.—To become a marine engineer on the Canadian lakes it is necessary first to obtain a fourth-class engineer's certificate. The following qualifications are necessary for a fourth-class certificate: The applicant shall (a) be over twenty-one years of age; (b) he shall have served an apprenticeship of not less than thirty-six months in a steam engine shop, and been employed on the making and repairing of steam engines, or if he has not served such apprenticeship, he shall have been employed for not less than thirty-six months as a journeyman mechanic in some workshop, on the making and repairing of steam engines; or (c) he shall have served at least thirty-six months in an engine-room of a steamboat, as engineer on the watch; or (d) he shall have served not less than thirty-six months as oiler on the watch in the engine-room of a steamer of not less than thirty normal horse power; or (e)

he shall have served not less than forty-eight months as fireman on the watch in the firehold of a steamboat of not less than thirty nominal horse power; (f) And in any of the above-mentioned cases of service, twelve (12) months' service in a boiler shop on the making and repairing of steam boilers, may be accepted in lieu of twelve months of the service named. (g) Service in the dual capacity of engineer and fireman, or oiler and fireman, will only be accepted as fireman service for fourth, and not for any other class of engineer. (h) He shall be able to read and write a legible hand. (i) He shall understand the construction and operation of the feed-water pump, water gauges and safety valves; he shall know when a boiler is foaming, and how to stop the foaming, and also the dangers resulting from neglect to keep the boiler clean, and the usual methods of cleaning it.

## PROPOSED SARNIA—PETROLEA RAILWAY.

A proposal has been made to build an electric railway from Sarnia to Petrolea, a distance of 16 miles, the scheme contemplating extensions to Point Edward at the Sarnia end, and to Oil Springs and Oil City at the Petrolea end, with an ultimate projection into the township of Dawn, which is a very rich agricultural area now being opened up for settlement, but without railway communication of any kind at present. Sarnia now has a horse-car system, operated by a local company, called the Sarnia Street Railway Company, and this company's charter, granted in 1874, gives the company authority to extend the road to adjoining municipalities within the County of Lambton, and the right of way would thus be provided for. According




to the census of 1891, Sarnia had a population of 6,692; Point Edward, which is a lake suburb, almost immediately adjoining, had 1,881; Petrolea, 4,357; Oil Springs, 1,138; and the county itself, which is a very rich agricultural district, a population of 47,715. The wages paid out each day in the oil industry of Petrolea averages $1,800 to $2,000, and those of Oil Springs about $700 a day. In summer the excursion traffic from Petrolea and the other inland towns to the breezy shore of Lake Huron would be very considerable, while the local traffic in freight and produce to Petrolea and Sarnia from the intervening rural districts would be constant and profitable. There are about 6,000 oil wells in Petrolea, and about 2,000 in Oil Springs, and the traffic due directly to the oil industry is large, and still extending. In Sarnia the new oil refinery of the Bushnell Oil Co.—one of the most complete and modern in the world—is now in operation, adding an important permanent industry to the town, while natural gas is likely soon to be a product of the vicinity. Sarnia and its suburb of Point Edward form an attractive summer resort. A wide, clean beach, affording a fine view of the immense traffic that streams up and down the St. Clair River to and from Lake Huron, together with pure water and pure air, render the scene delightful to an excursionist, while recreation is already provided near at hand in a handsome park and pavilion, a race course and bicycle track. In short, the conditions seem already complete and the time ripe for a good paying enterprise, while the whole tract being a dead level, the cost of construction and the cost of maintenance would both be lighter than usual.

## A MODERN PRINTING ESTABLISHMENT.

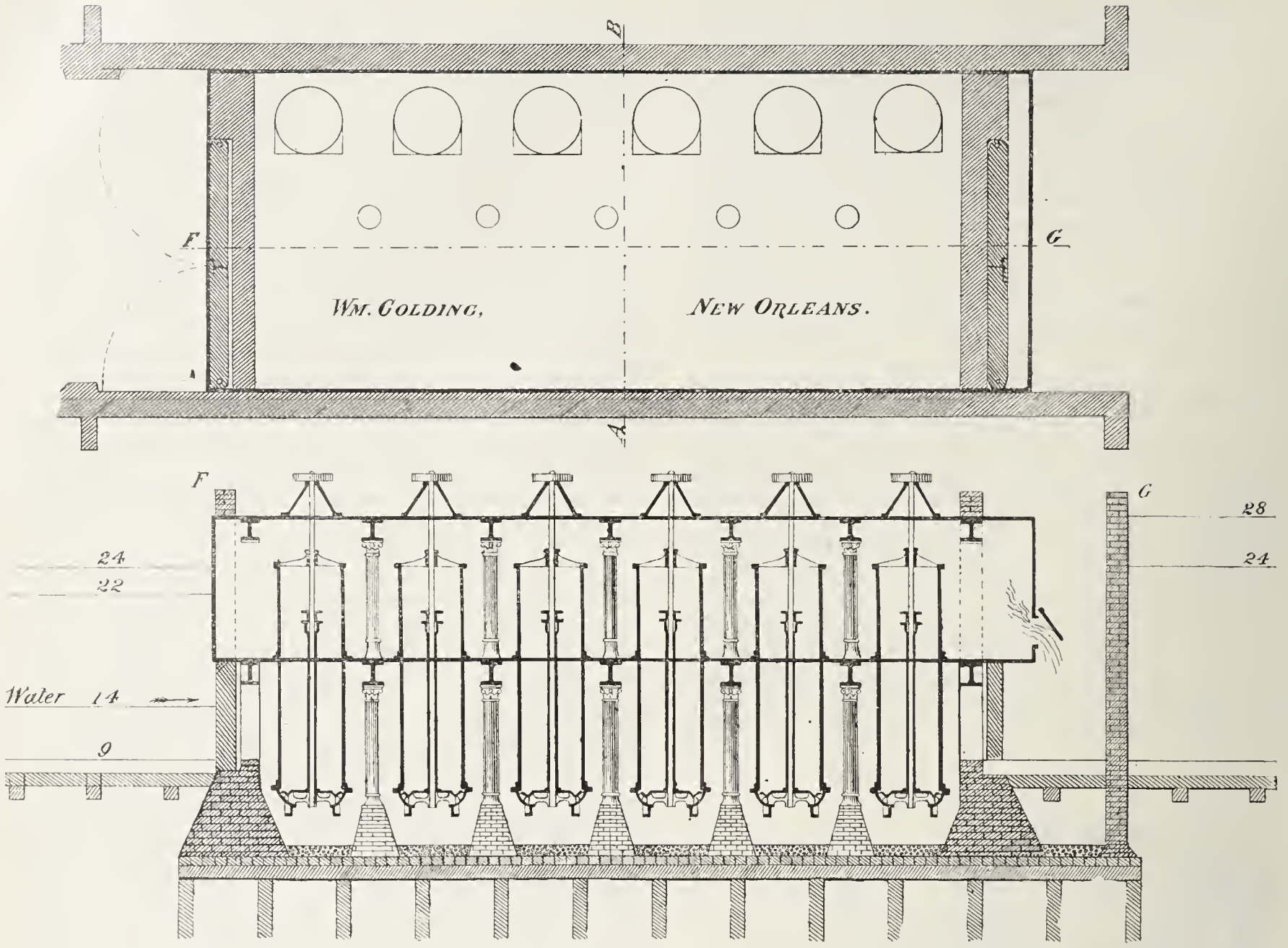
The largest printing establishment probably, in Canada, is that owned by the Methodist Church, and known as the Methodist Book and Publishing House, situated on Richmond street west, Toronto, and having a frontage also on Temperance street. The Richmond street building has a frontage of 100 feet, and is four stories high, besides basement. Here are situated the retail department, the editor's offices, and the offices of the various connexional offices of the Church, a board-room, etc., etc. The Temperance street front extends over 118 feet, on which is a six-story building, with basement, containing engine and boiler-rooms, shipping offices, wholesale book department, bindery, folding, and stereotyping rooms. Connecting these buildings is another structure of four stories, in which is contained the press room, composing room, book stock-room and general offices and a store-room.

In the press room there are eighteen large cylinder presses, two of which are perfecting or double presses, a full complement of Gordon presses for small work, a folding machine, paper cutter, and everything necessary for turning out work expeditiously. The composing room is a handsome and airy apartment, with frames to accommodate about eighty compositors. Two linotype type-casting machines of the latest pattern form part of the equipment. The bindery has the latest and best machinery for turning out all kinds of binding work in leathers and cloths. Here will be found embossing presses, cutting and trimming machines, gilding, sawing, sewing, wire-stitching, backing, and case-making machinery. The stereotype and electrotyping room is complete with dynamo, casting boxes, sawing machine, routers, bevellers, furnaces and all necessary tools.

The buildings are heated entirely by steam. The mechanical departments by exhaust from the engines, the front building, offices, etc., by the low-pressure gravity system. In the boiler-room are two 60 h.p. boilers, made interchangeable for high and low pressure. These are fed by a Northey steam pump. In the engine-room are three engines, two Wheelocks, 60 and 90 h.p., connected to an underground shaft by large belts, and arranged with friction-clutch pulleys, so that either engine or both may be used at any one time. The building is lighted by electricity, generated by a 10½ by 10 in. Ideal engine direct connected to a 30 kw dynamo, which has lately been installed by the Toronto Electric Motor Co. The generator provides current for 650 16-c.p. lamps. From this machine there can be run as well, however, through motors, arc or incandescent lights. The armature of the generator is of the wave-wound type, with ventilated core, the armature being so constructed that no wire passes over the ends. Consequently no dust or dirt is allowed to accumulate. The crown is of heavy iron, with the laminated poles cast in so that the magnetic current is perfect. It is the most modern type yet out, and is the first of the kind ever built in Canada. It has run with a superlative smoothness since its installation. The establishment is protected against fire by two large stand-pipes running from cellar to roof, with hose on each flat attached and ready for use. G. C. Mooring has charge of the steam plant and machinery, and has been with the firm over eight years. He is a chartered member of Toronto No. 1, C.A.S.E., and having always taken great interest in the work of the order, he has recently been elected president of the Toronto Association.

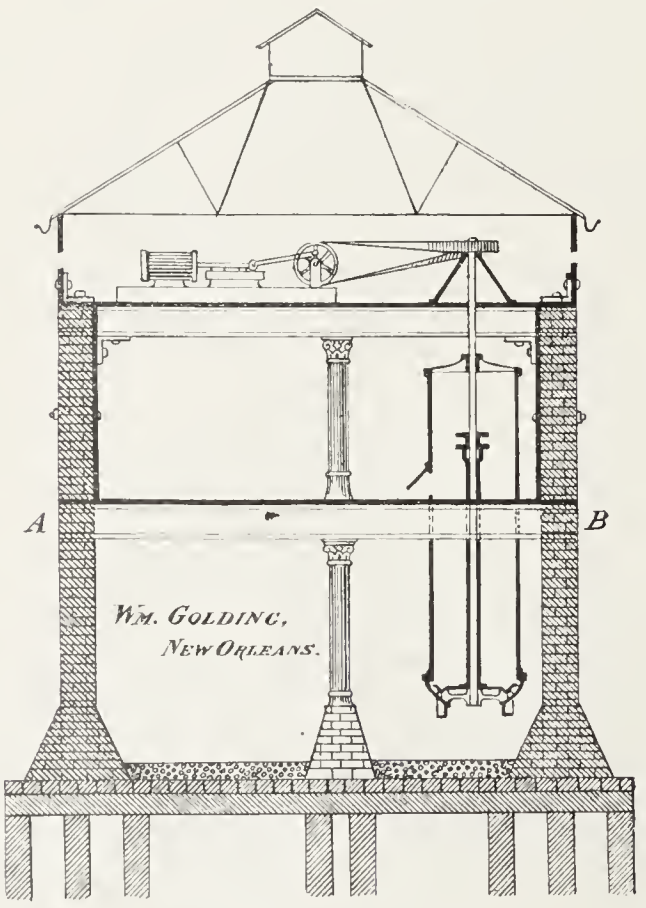
This thriving institution had a humble beginning in 1829, and has attained its present high position by steady and persistent energy, combined with honorable dealing. During the past decade, under the management of the present book steward, Rev. Wm. Briggs, D.D., its growth has been phenomenal, and notwithstanding that it has but recently moved into its present quarters, its expansion has been such that it was found necessary to acquire additional ground to permit of extensions in the near future.

ROBERT JAMIESON, the chief engineer of the West Kootenay Power and Light Company, which is putting in a big electrical plant on the Kootenay River, says work is being pushed in all departments of the enterprise, and the company expects to be supplying power in Rossland, B.C., by December 15.




## PUMPING PLANT.

The accompanying illustrations show a system of pump installation, in which the water is lifted no higher than is necessary to effect the discharge, against the varying surface heights of the out-fall receptacle. Steel beams cross the walls at A. B., upon which is placed a steel tank, through the bottom of which are suspended several centrifugal pumps, which receive




the water from the pit, and deliver it into the tank, from which it flows to the out-fall receptacle. The bottom of the tank is placed on a level with the minimum height of the out-fall receptacle, while the top of the tank will be placed above maximum height of out-fall receptacle..

The pumps will be placed on one side of the tank, in order to form a by-pass for the water to run through without pumping, when the conditions are favorable. On the top of this tank will be erected a suitable building of iron, in which will be placed the operating machinery. It will be understood that if the surface of the out-fall receptacle should rise to line 24, the valve shown at end of tank would close, and would remain closed until the water inside of the tank was raised higher than the water on the outside. The motive power, either steam, gas, or electricity, will consist of a motor for each pump—the object being to start one pump at a time, as the water commences to flow. Where the conditions are such that the maximum height of the out-fall receptacle exists but a small portion of the year, the advantages of this system will be fully appreciated. This pumping system is the invention of Wm. Golding, C.E., New Orleans.

## THE NAVIGATION OF THE AIR.

*Editor* CANADIAN ENGINEER :

Balloons to date have always been symmetrical in cross section, or around on either vertical or horizontal axis of rotation. They have been spheres or spheroids, and when the latter, sometimes oblate, sometimes prolate, that is, elongated as the lemon, squat or flattened at the poles, as with the orange or the apple. They have also been made ovoid, as the egg, and even spindle-like, as the weaver's shuttle; but always symmetrical in any and every section, perpendicular to the axial line.

Thus there has never been an attempt, as with flying machines, to imitate in a balloon the shape of a bird on the wing; and yet there should be, there must be, to be successful in directing them, as man has become in propelling vessels through the water by building them in imitation of the fish. Nor will flying machines ever prove a success until some closer imitation has been arrived at than heretofore, of the winged denizens of the air. These have been supplied with machines which have to perform the double duty, not only of propulsion through the air, but of ministering the while to their buoyancy.

This necessity must be eliminated, and can be, in flying machines, by having a space inclosing structure, approaching in point of weight to that of a more or less perfect vacuum, by

inflation, as is usual, by a lighter gas than air, as hydrogen—some fourteen times lighter, bulk for bulk, than air—and this requiring less place or bulk to do the needful, or with the heavier coal gas, by increasing size of air buoy. Thus, as it is, the balloon is buoyant, but without the proper shape to render it possible to direct its motion, while the sky-flyer is deficient in the opposite sense of having the power of direction without the buoyancy.

Now then, let us try to conciliate or combine the two requirements or desiderata; for as there is so to say but one kind or shape of fish or vessel to navigate the sea, there can also be but one kind of vessel to navigate the air; and the balloon and flying machine as now distinct from one another, must be blended (except for mere ascensional, observational, or meteorological purposes, where the balloon as now made may suit the purpose) into one and the same structure, and as closely as possible approximating to the figure of a bird on the wing.

This may be done by building the balloon or sky-flyer more or less crescent-like, or in the shape of a crescent in its cross section or that perpendicular to its axis of direction. The bird gains buoyancy by plying its wings, spreading them concavely to the air, as a swimmer does with the hollow of his feet and hands against the water which he leaves behind him, and preparatory to another stroke, lengthens out his feet and hands to their minimum cross section to draw (the feet) or thrust (the hands) forward for a renewal of the action; the same again as to propel the boat, the blade of the oar is held flat against the water, and then turned edgeways, pending the interval required for another stroke; or again, the same as with the paddles of a steamer, as soon as they have done their duty in and through the water, they are made to turn edgeways before leaving it, to prevent back-water. This must be done, or no success will be forthcoming. The bird must be imitated, both in its shape and in its motion. Watch it then carefully, look at it from beneath when you get a chance of doing so. We have already seen how it ascends by the ply of its wings. Now it has attained its height, and soars aloft, no more by the motion of its wings or by moving them, but by spreading them, and it spreads the feathers of its tail, till they reach and underlap them, and then you have the surest parachute. The bird, though, must move or soar as it is called, but it does so bodily, or as a whole, now acting as the kite or as the aeroplane, which the slightest motion keeps afloat, either by its own advance in perfectly still air, or by the motion of the air in the contrary direction, when the kite, or bird, or aeroplane, moves against the wind or breeze; and similarly does and must the cyclist move when soaring, so to say, on his wheel, or at a standstill or slow motion, by curving slightly to one side, then the other, to retain his vertical position in space.

But there is another cause which helps the bird to soar on air, and which I do not remember as yet to have seen noticed, any more than does the centrifugal action of floating ice or other objects, such as the remains of the "Jeannette" or other wreckage, appear to have ever been taken into the calculation, or in any way considered as a factor in the computation as well as circum-polar currents, etc., in Arctic navigation.

This is the very heat generated by the bird's body, and we all know how immensely hot a bird feels when you hold him from beneath. This heat then imparts itself by radiation and conduction both, to the air contained in the concavity between its wings, it heats this air and thus rarefies it and makes it lighter, with the tendency, if not to further lift the bird in space, at any rate, to keep it there or on the wing, and prevent its tendency to fall, which it would do, or at any rate, descend, as with an ordinary non heat-generating parachute.

And this soaring of the bird, the bird of prey especially, is due to its meat or flesh-devouring propensities, and of fatty and oily substances creative in the blood of vast amounts of carbon, which, when brought into contact with the oxygen of the air in the bird's act of active respiration, sets fire, so to say, to the interior, with the effect alluded to of thus maintaining its not otherwise-to-be-explained faculty of keeping almost indefinitely on the soar.

Again as in the so-called ball-cock mystery, of which I was the first to explain the apparent paradox; buoyancy, or additional or increased buoyancy might be obtained under a parachute or flying machine of the kind, by causing a jet of steam from a boiler of the propeller, if such were used to give motion to the flyer, or a jet of gas of any kind, or of atmospheric air, to issue from a reservoir of compressed gas or air, or from an air or gas compressor worked by the engine, and either by electricity or any other motive power, to issue from a conical nozzle with a ball near its apex, or from the conic space between two concentric cones, and at such an angle as required to cause the funnel-like jet to pass out in contact with the circular periphery or outer and lower edge of a conical or concave roof or ceiling to the flyer, which (the jet) as in the case of the similarly shaped water nozzle, would, by the mere effect of its friction on the air contained beneath the parachute-like covering, roof or awning, suck the air from the space enclosed between the awning and the funnelled jet of gas or air in a way to form a vacuum or partial vacuum within; and again, in this way be productive of the buoyancy required to float the flyer, and allow of applying the power of its motor or the balance of such power, as the case might be, to the propulsion of the bird-like structure through or into space.

But better still, let the buoyancy be provided for in advance of starting, by making the structure a balloon or space-enclosing one, and let the car and motor be held beneath the balloon in the concavity between its horns, already spoken of, by building it as said, of crescent-shape in its cross section. Its weight might be borne by rods or ties from horn to horn, or it might be suspended to the under or concave side of the aerostat or to suit its height to all requirements, its head might rise air-tight, of course, into the very balloon itself, and be there maintained in shape by suitable light steel ribbing.

Now on either side the car and perpendicular thereto, or symmetrically and at whatever angle, there might go forth axles of motion, and these axles might either pass beneath or through the pendant horns of the crescent, coupled thereto if passing beneath them, or if passing through them, would do so through fixed tubes concentric in direction with that of the axles, and with joints at either end made impermeable to the space-filling medium of the air-ship. Then to the ends of these axles, projecting as required beyond the tubes, would be attached such paddle-wheels or motor-blades as required to propel the ship through space; and by making the axles separate or capable of separate action, the one from the other, both would be made to revolve or work at the same velocity for straight motion or motion ahead in a vertical plane, or one of them to work slower than the other when starting on a tack, or the one backward and the other forward for speedy rotation of the vessel or a change in direction, end to end. And if the tail-end of the aerostat were provided with a rudder, this could be easily worked from the platform of the car by an endless chain or rope passing through sheaves and pulleys attached to the bottom or concave side of the imitative bird, or again a screw or helix,, or a pair of them (twin screws) could be as easily handled from the car.

I have as yet said nothing of the balloon in longitudinal section, nor of its plan or shape as viewed from above or below; but from what I have said about a bird-like structure, it will have been inferred that the rear end of the airship should be like a lobster's tail, and the whole bag of gas fan-like in plan, while its head or nucleus should, except for its concavity beneath, be like that of Newton's great comet of 1680, Halley's comet of 1835, the six-tailed (feather-like) comet of 1744, that of 1811, and even those of by-gone ages, as of A.D., 1006 (supposed to be Halley's, of 1835), are described in the annals of the time as exhibiting a tail in the form of a scythe, as if their mighty flight through space (at a million miles or more an hour when under perihelion influence) as if concavity of the tail while traversing ethereal space, were akin to that formed by birds traversing atmospheric space, or that their heating of the ether in their concave surface had something to do with an ethereal vacuum supporting them in space.

But I had better keep out of ether and get back into air, with the concluding remark that such a shape of balloon cross-section would, in case of collapse or of a rapid coming down, in case of a burst or rent in its enclosing skin, cause it to fall on its horns, which, being made of certain amplitude or thickness and lower rounded edges, as I should have said before, would act as buffers on land and water to deaden the fall or force of impact. The balloon, it is likely, should be ribbed, and all its ribbing and impelling machinery be made again in imitation of the bird, of light steel tubing (birds' bones being hollow), thus affording increased strength with less material, and as such ribbing would, even in case of a burst and escape of gas, maintain the shape and keep the enclosing material in position, this would be highly conducive

to the prevention of accidents, since even without the gas within it, the outspread cotton, cloth, or silk, or of whatever material the coverings were made up, would be sure to stay the velocity of descent and effectively prevent casualties, and here again we take our cue from the bird; for though when, after soaring it perceives its prey, it swoops or shoots down like an arrow, closing its wings and the feathers of its tail the while, but when near the earth it spreads them again to break its own fall, which otherwise would prove as fatal to it as that of a man not armed with a parachute for the purpose of retardation.

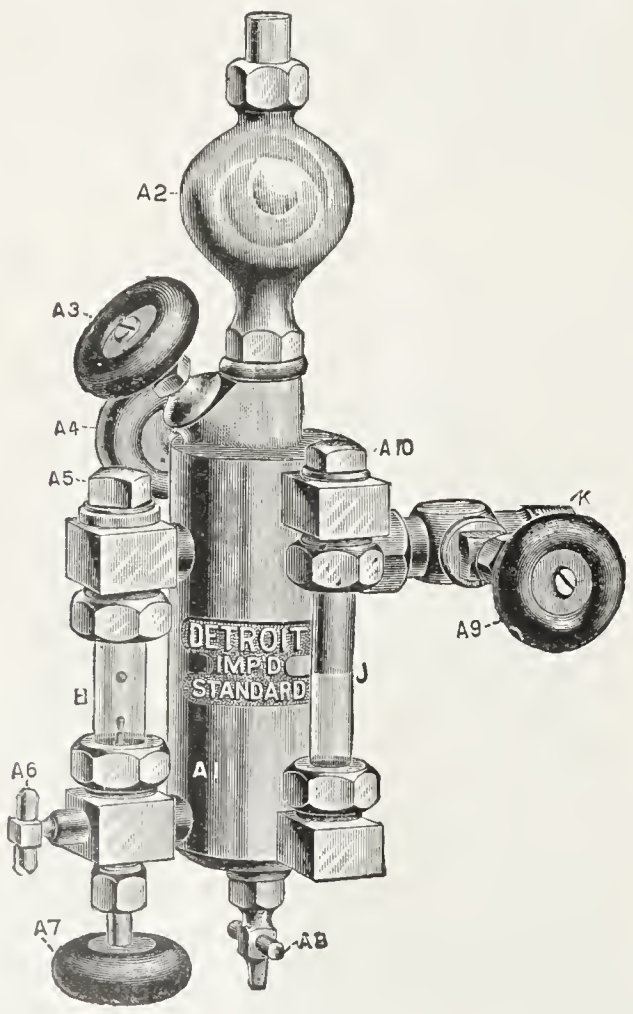
Quebec, October 25th. C. BAILLAIRGE, C.E.

## LUBRICATION OF STEAM CYLINDERS.

Proper cylinder lubrication is a much more prominent factor in the performance of the steam engine than most engineers or engine users suppose. For years its importance has been recognized by the experts, the inventors and designers of high-grade engines, and a more correct estimate of its influence has pervaded the rank and file; still, it will be a matter of surprise to many to learn that with the exception of the initial condensation of steam, the greatest loss about a steam engine is due to the friction of the slide valve and piston.

In their new catalogue, just received from the Detroit Lubricator Co., of Detroit, Mich., is given some very interesting data on this subject. It consists of reports of the results of tests made at one of the most prominent testing plants in the United States, not by the makers of lubricators, but by mechanical engineers, who are purchasers and users of these articles. These tests proved that with a well lubricated slide valve and cylinder, an engine can do 35 per cent. more work than when these parts are not well oiled. That these results are not exceptional, it might be added that they have been approved by a great many of the leading American engineers, and Prof. R. H. Thurston, of Cornell University, in his book on Friction (recognized as the standard work on this subject in engineering circles of the United States and Europe), estimates the loss due to imperfectly lubricated slide valves at from 25 per cent. to 50 per cent. of the energy of the steam used.

Sight feed lubricators are designed to prevent this loss of power. There are different kinds of different degrees of merit,

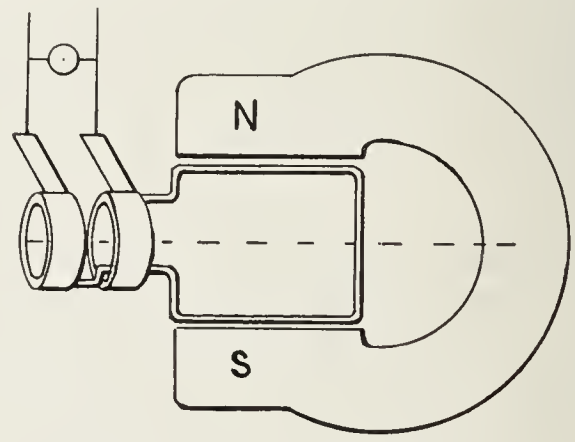



some very crude, and many very thinly disguised imitations of antiquated patterns. As an illustration of the progress that has been made in these devices, we insert cut of the improved standard lubricator for stationary engines, made by the above-named company. In it are included all the improvements and advantages, which in their more than 20 years' experience, they have found to be necessary or desirable. Among these advantages is its heating channel. This extends through the body, between the upper sight feed arm and the support arm, and it is always filled with steam from the steampipe. Thus, no matter how cold the weather, or how heavy the oil, the same number of drops per minute is always maintained, and perfect lubrication assured under all circumstances. The globe valve in the support arm makes it easy to attach, and allows the lubricator to be removed at any time, for repairs or otherwise, without letting down steam. The necessity for repairs, however, is a rather remote contingency, as each lubricator made by this company is tested at a pressure of 300 lbs. before it is allowed to leave the factory. Perhaps the best evdence of the merit and popularity of these goods is the fact that more than 350,000 of them are in use on the engines of almost every country of the globe, so that their motto, "We Lubricate the World's Machinery," is not such an exaggeration as might at first sight be supposed. Our readers will find the new catalogue referred to, to be quite an acquisition to their library, and very useful for reference. It shows the full line of sight feed lubricators, kerosene oil injectors, glass and brass oilers, oiling devices, valves, low water indicators etc., made by the Detroit Lubricator Co., and a copy can be obtained free by addressing the company at Detroit, Mich.

## DIRECT AND ALTERNATING CURRENTS.*

You are all aware that direct or continuous currents are so called from the quality which they possess of maintaining a uniformity of direction of flow with regard to the conductor through which they are passing. Direct currents, however, are not always of constant pressure; but are often intermittent or pulsatory in their character, and under such conditions exhibit many of the characteristics of alternating currents, which are constantly fluctuating with more or less rapidity from a positive value to the opposite or negative value many times in a second. The frequency of commercial alternators varying from 25 to 140 complete periods or cycles per second.

I shall not attempt in the short space of time you have to listen to me to-night to skim over the whole field, but will confine my remarks more particularly to the kind of electric currents the steam engineer is more apt to come in contact with. The rapid strides that electricity is taking makes it important that all should familiarize themselves with the laws governing this subtle force. Most any of you are liable to be placed in a position where you will have charge of one or more dynamos for generating electric current for lighting or power purposes, and it is to dynamo electric current that I shall more particularly refer to-night. I assume that you are aware that metallic substances are good conductors, copper being the best commercially. Also that most other substances are poor conductors, some being such poor conductors as to be termed insulators, such as glass, porcelain, dry wood, paper,



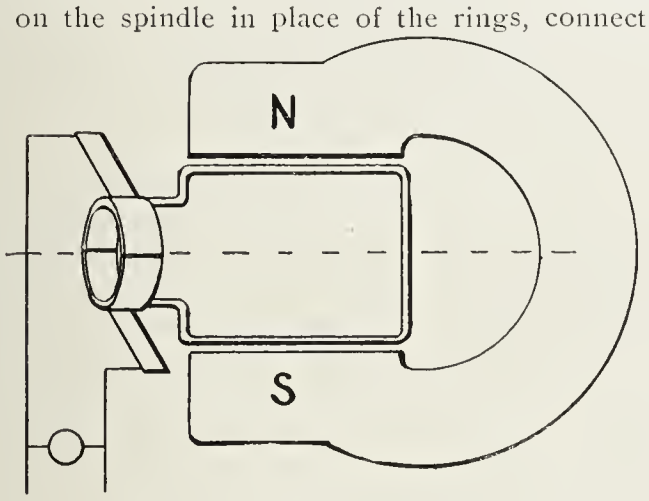

ALTERNATING CURRENT DYNAMO.

and cloth. The great Faraday, who may well be called the father of the electric dynamo, discovered in 1831 that when a coil of wire was made to approach a magnet, an electric current was momentarily established in the coil, as indicated by the deflection of a galvanometer connected in circuit with the coil. This discovery was followed by a series of experiments probably unequalled in any branch of scientific research for brilliancy of perception and clearness of reasoning power. This philosopher, before his death, gave to the world the fundamental principles upon which the dynamos of to-day are constructed.

Starting with Faraday's principle of induction, let us construct a very simple form of dynamo. Take an ordinary horse-shoe magnet, and for simplicity I will show a single

*Paper read before the Canadian Association of Stationary Engineers, Toronto No. 1, by F. H. Leonard of the Toronto Motor Co., 20th Oct.

turn of wire arranged to revolve in the magnetic field, if to the two ends of this coil of wire we attach a pair of rings, and on them place two strips of thin sheet copper for brushes to conduct the current to the outside circuit. We have all that is essential for our dynamo. If in the circuit of this elementary dynamo we place a galvanometer—which is an intrument for indicating the flow of electric currents—we shall find that as we turn the coil about there will be a deflection of the pointer of our instrument, first in one direction, then in the opposite, as the coil in our dynamo assumes first one, then the other position with regard to the magnet. We have produced then an alternating current. If we wish to obtain direct currents, we must change our construction, and substitute in place of our two rings a commutator, which in its simplest form consists of two sections. We will split a piece of tube in two, and mount it on the spindle in place of the rings, connecting one

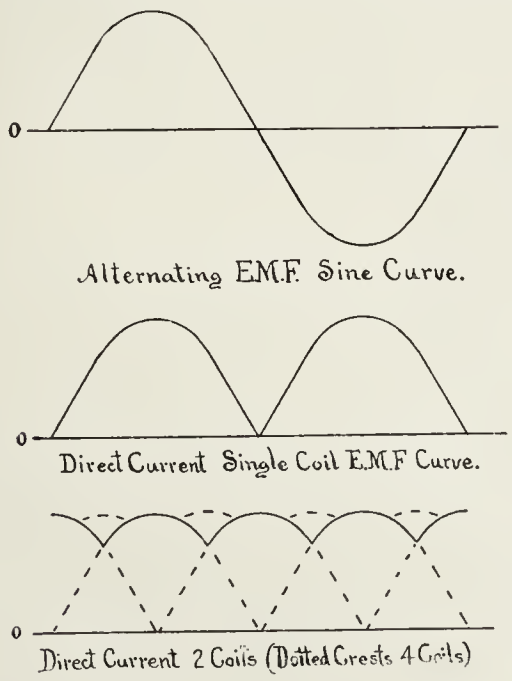



SINGLE COIL DIRECT DYNAMO.

end of our wire to one part, the other end to the other part, insulating the two parts from each other, so there will be no electrical connection between them. Again, we rotate the coil, and we shall find the galvanometer deflection takes place always in the same direction, but comes to zero at each half revolution of the coil. We can represent by a curve just what takes place in the coils or armatures of these two forms of dynamos during the period of one complete revolution. Just as the steam engine indicator represents the pressure at every part of the stroke, so our curve will show the electro motive force at every point of the revolution.

The E.M.F. (electro motive force) curve of our alternating dynamo, starting from a line of zero potential, will rise more or less abruptly, depending upon the design of the dynamo to a point of maximum positive potential, then droop, and passing the neutral or zero potential line, descends to the point of maximum negative potential.

The most desirable form of all-round work, and the one which most modern, well-designed alternators follow, is the sign curve. Though many single phase alternators, which are perfectly satisfactory for lighting purposes, depart considerably from this form and show a peak-topped, and some a flat-topped, curve. The E.M.F. curve of our direct current dynamo differs from the alternator for the reason that the commutator replacing the collector rings slips from under one

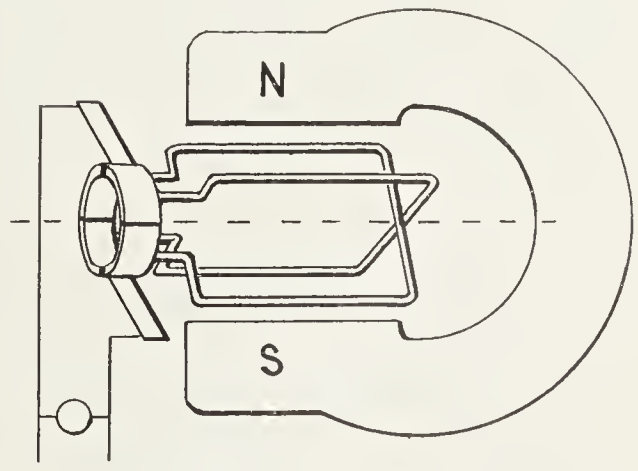



brush to a position under the opposite brush, just at the moment the current in the coil is about to reverse, and instead of descending below the zero line, it again ascends, making in a complete revolution two curves, similar to the first half of our alternating current curve, both of which are above the zero line. Such a curve represents a series of impulses following each other with every half revolution, and would not make a satisfactory current for practical working. Other evils would also creep in, as we multiplied the number of turns to obtain the commercial voltages which would produce vicious and destructive sparking at the commutator.

To obtain a commercial dynamo for direct currents we must then alter our design, and instead of using a large number of turns of wire in a single coil, we must divide these turns into a number of smaller coils, and furnish segments in our commutator to correspond with the increase in number of coils. We will first see the effect of two coils spaced equally around the periphery of our armature with a segment attached to each end of the coils.

Now, if we trace an electro motive force curve from this armature, we shall find that the pressure does not fluctuate so much as with the former arrangement, and instead of dropping to zero at each half revolution, the pressure is always maintained at a point of considerable pressure, for the reason that soon after a coil has passed into a position in the field, where the rate of cutting lines of force is less, the commutator sections corresponding to this coil have slipped from under the brushes, and the sections connected to the other coil have passed under and into contact with the brushes, and supplies the circuit with a fresh E.M.F. rising in potential, the other coil in the meantime is out of circuit or idle. If, instead of two coils we employ a still larger number, we continue the process of smoothing out till we finally get a practically constant pressure throughout the revolution. Also, as we multiply the coils we shall find it desirable to avail ourselves of the E.M.F. generated in the coils, which are not in a position of maximum potential, and utilize the potential of coils rising to maximum and descending to zero; this will also materially reduce the sparking at the commutator. Thus, all the coils in a commercial dynamo are connected together, and loops taken to the segments of the commutator, except in a few cases, notably the Brush arc dynamo.

So far the dynamos we have been considering have been constructed without iron in the armatures, but as iron is a much better conductor of the magnetic lines of force, which are depended upon to induce the E.M.F. in our coils, it would evidently be better to introduce an iron core into the structure, thus reducing the reluctance of the magnetic circuit. Also we have used a permanent horse-shoe magnet, whereas we can obtain a much more dense and powerful magnetic field by using an electro magnet, which may be obtained by passing the electric current through a coil of wire surrounding an iron core. The shorter and thicker we can make the magnetic circuit, the less energy there will be required to produce the magnetic field, and wide air spaces are to be avoided, as they offer serious resistance to the flow of lines of force through




TWO COIL DIRECT CURRENT DYNAMO.

the magnetic circuit. Part of the electric current generated by the dynamo itself is generally utilized to excite the field of direct current dynamos, though alternators are usually separately excited by a smaller direct current dynamo. What applies to the magnetic circuit in a direct current dynamo is equally true in regard to an alternating current dynamo. Care must of course, be taken, to insulate the copper of the electric circuit from the metal which is used for the magnetic circuit, as well as to insulate the various turns or convolution of the electric circuit from each other, so as to avoid short circuits.

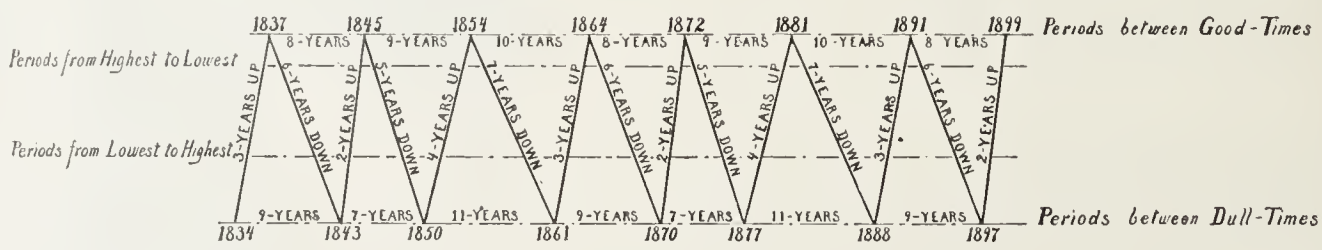
From what has been said, I trust you have been able to form a fair idea of the manner of obtaining both alternating and direct currents by means of the dynamo electric machine,

which is only a piece of apparatus for transforming the mechanical energy of the water-wheel or steam engine into electrical energy. There are several types of direct current machines, but they can be divided into two principal classes—constant current dynamos and constant potential dynamos. The constant current dynamo is used principally for arc lighting, the flow of the current remaining fixed while the E.M.F. increases as the arc lamps or other devices are added in series. The constant potential dynamo is the type generally used for incandescent lighting and power purposes. This type of dynamo is designed to maintain a constant E.M.F. or pressure, and the current is increased as lamps or motor are added to the circuit in multiple. Alternators are also built for constant current and constant potential, though the former are not much used at present.

Direct currents are generally used at low E.M.F., 110 to 125 volts being common for lighting plants, though in arc dynamos the pressure in the larger sizes reaches as high as 8,000 volts. At 110 to 125 volts, of course, large conductors would be necessary to supply any considerable amount of energy, which necessarily confines this type of dynamo to limited areas, so the work can be reached without too large an expenditure for copper conductors. The alternating currents, however, on account of the facility with which they can be transformed from a high to low voltage or vice-versa, without the necessity of any moving parts in the transformers or convertors, as such devices are called, are generally used for transmitting energy to greater distances, and for distribution covering areas of many miles, the Niagara power being transmitted 26 miles to Buffalo by alternating currents generated by 5,000 h.p. two phase alternators at 2,000 volts transformed to three phase alternating currents at 10,000 volts for the transmission, and at Buffalo transformed from 10,000 to about 340 volts alternating, which is then transformed by rotary transformers into direct current at about 550 volts for supplying the street railway motors. As can be seen from this instance, the flexibility of the alternating current system is wonderful, particularly when it is understood that these transformations take place in the static transformers with a loss of less than 2 per cent. for each change, the greatest loss for any change being in the rotary transformer, and even this is obtained at an expense of about 5 per cent. Under the high pressure alternating currents are transmitted with allowable loss and transformed to the lower and safer pressures on the spot where the current is to be utilized. It is difficult in so short a space to give much of an idea of either direct or alternating currents, not to mention their differences, but have tried to touch on a few points, which I hope will awaken sufficient interest to bring about a deeper study of the subject.

## PIG IRON AS A TRADE BAROMETER.

It was Lord Beaconsfield who pointed out that the chemical market was an indicator of the trade conditions of the world. When chemicals were active, trade and manufactures flourished, and when the chemical market was depressed, trade languished. F. S. Evans, of the well-known bicycle firm of Evans & Dodge, Windsor, Ont., shows that pig-iron is even better than chemicals as a trade barometer, as it is the only great staple that is affected by nothing but the law of supply and demand. Mr. Evans has, with great patience, worked out the accompanying graphic table, showing the fluctuations in pig iron back to 1834, these being taken from American prices current, as quoted in the markets and trade papers. It is remarkable with what exact regularity the periods of high and low prices recur, not only in these short cycles, but in the long cycles. For instance, taking the range of highest prices, we have a long cycle of eight years, nine years, and ten years, recurring in the same period as time goes on; and in the lowest points there are similar periods of nine years, seven years, and eleven years, which are repeated in regular order from 1834 till now. Projecting the lines forward into the future, we find that prices will continue to rise till they reach their highest point, in 1899.




It may be noted that the present tendency of prices in pig iron confirms the correctness of Mr. Evans' instructive table.

## EVAPORATIVE CONDENSER OR COOLING TOWER.

Recently President E. J. Philip lectured before the Hamilton branch, C.A.S.E., on this subject. The substance of his remarks was the same as his paper read at the Brockville convention, and published in full in the September number of THE CANADIAN ENGINEER, with some additional explanations and matter, bringing the discussion up to date. We append the portions of his lecture not found in previous numbers, the whole making a complete statement of the question:

The evaporative condenser or cooling tower is made to operate where the supply of water is limited, or where it has to be bought. This apparatus is in every way the same as an ordinary condensing plant, except that in addition to the air-pump and condenser there is a tower for cooling the water after it has been heated by condensing the steam. Its construction will be taken up later on.

This apparatus is the outgrowth of the increasing number of steam power plants in recent years, with vastly increased h.p. capacities, which has of necessity raised the price of the lower grades of coal. Whenever fuel goes up in price, or where the quantity is increasing, due to increased load, the steam user begins to look around for some means of reducing the rising fuel account During the last few years, engineers have had every opportunity to put in what may be called "ideal plants," and others have had the opportunity to improve the plants under their control. How far many have succeeded is known only to themselves; if any part is a success it becomes known, and is copied or improved on. The principal improvements during the last few years have been due to higher steam pressures, increased number of cylinders, and where water was at all available, running condensing; and the absence of water in sufficient quantity to use for condensing purposes at a point where it is desirable to locate a power plant, has caused it to be located at some remote or less desirable point, the necessity of having water for condensing purposes being recognized as leaving no alternative. The cost of running condensing and using water from a city main is out of the question, as it costs more for water than is gained by condensing: this being the case, it formerly left no alternative but run non-condensing, or build the plant where there was an abundant supply of water without regard to the disadvantage of the location.

This has been overcome by improvements in an apparatus that has been used for years in a crude form for other purposes. The first purpose it was used for was for cooling water that had been used for cooling beer. This form of tower was simply a square frame work, filled with brush or limbs of trees, the water was pumped to the top through a sprinkler, and in falling over the loose brush it spread out in thin sheets over the surface of the wood, and was acted on by the air, the warm water causing a current of air to circulate through the filling. The present tower is simply an improvement on the original form, and when used in connection with a steam engine it takes the place of a natural source of water supply. With this apparatus a plant can be made to run—condensing, with less water than it can run non-condensing. The reason of this I will explain after a description of the tower, which will now be in order: The cooling tower is usually square or rectangular in form, but it is sometimes made round, and is filled with partitions. The partitions may be made of any material. The Worthing tower is filled with tile, the Barnard tower is filled with wire netting, the Gradier with wood, and sheet iron has been used by different parties. Any material that will give a large surface will do, the object of the partitions being to spread the water out in thin sheets over the surface. The partitions do not extend to the bottom of the tower, but a space is left below them into which a fan discharges air. At the top of the tower a distributer is attached

to distribute the water over the partitions. Now, the action is this: Imagine an engine running condensing, and taking its injection water from the bottom of the tower (into which a quantity is put when the tower is first started). Now, when this water has condensed the steam, and passes on to the air-pump, instead of the pump discharging the water to the sewer, it discharges it to the top of the tower into the distributer, where it is evenly distributed over the filling. It spreads out in a thin film or sheet, and passes slowly down the partitions. The fan is running, and its air is passing up between the partitions, and acts on the water in two ways, thereby cooling it by the time it reaches the bottom of the tower sufficient to again condense more steam. The way in which the water is cooled is: First, the water looses some of its heat by radiation from the piping between the tower and condenser, also from the sides of the tower. Next, the air is raised in temperature, carrying off heat in this manner, and the last, and by far the greatest cooling effect, is obtained by the air evaporating a certain quantity of the water, carrying off heat in the vapor as latent heat.

I made the statement that with this apparatus a plant can be run, condensing, with less water than it can be run non-condensing, and I will try and prove this. Take an engine running non-condensing, and using, say 25 pounds of steam per h.p. per hour, and taking its water from the city main; if it is, say 100 h.p., it will use 2,500 pounds per hour. Now, this water is being exhausted out into the air in the form of steam. If we attach a condenser and cooling tower to the engine, and it saves at the engine, say 20 per cent., the engine will use 20 per cent. less water, which will make the water consumption 20 lbs. per h.p. per hour, or 2,000 pounds per hour for the 100 h.p. When condensing, instead of the water passing off as exhaust steam, it is pumped into the cooling tower, and for every pound of water evaporated by the air, sufficient heat is carried off to cause a cooling effect sufficient to condense one pound of steam. If all the cooling effect that took place was due to evaporation, there would be water neither gained nor lost, as there would be as much evaporated as condensed, but as I said before, a certain cooling effect by radiation takes place, and the water cooled in this way can do the work of cooling, and is not evaporated. Then the rise in temperature of the air carries off considerable heat without evaporating any water, so that between these two, sufficient water is saved to cause a slight overflow from the tower all the time, and as the boilers are using 20 per cent. less water, it follows that in this way you are running condensing with 20 per cent. less water than you can run non-condensing.

The tower that was built this summer where I am employed is a rectangular structure, 19 feet high, with a vapor stack on the top, 9 feet in diameter, and 26 feet high; the body of the tower is 10x12. It has an 18-inch water space at the bottom, and two five-foot fans. The filling is 12 feet long, and principally wire. The distributer is made of pipe, and works very nicely. The tower runs in conjunction with a 500-h.p. surface condenser, with combined air and circulating pumps, built by the Northey Co., of Toronto. The condenser has 800 brass tubes 8 feet long, making over a mile of tubing, with 1,600 stuffing boxes. The water leaves the condenser at from 120 to 128 deg., and is cooled by the tower to from 68 to 90 deg., according to the amount of air. It is possible to get almost any cooling effect by varying the quantity of air; the water has been cooled to 60 deg., with the outside temperature at 78 deg.

## DYNAMO TROUBLES AND HOW TO OVERCOME THEM.*

With modern uses of electricity, the increase in the demand for light and power has, in many cases, proven too much for modern power stations to meet. These plants, installed ten or fifteen years ago, when the general application of electricity to purposes of illumination first became evident, have now become obsolete or so far behind the times as to be unable to furnish a satisfactory service. These same installations under ordinary circumstances, to the uninitiated, apparently give perfectly satisfactory results, and the question is often asked by directors of companies, "Why purchase new machinery when we are filling the bill with the old? We have had a few mishaps, it is true, and the power has been shut off for a short time now and then, but what does it matter if we do stop for a few minutes, or even hours, if we give all that is necessary during the rest of the time?" Now the consumer of the present day when he pays for a thing expects to get it. It is so with the man who is depending on the electric company to light his house or to furnish power to run his shops, as the case may be. It is in nine cases out of ten that the power is shut off at a critical moment; hence it is that these companies with obsolete machinery fail to keep their customers, many of whom feel compelled to install the more isolated plant.

With the introduction of so many of these isolated plants it becomes necessary for the stationary engineer of the present day, who is called upon to take charge of dynamos and motors in connection with his engineering duties, not only to be posted thoroughly as to the care and running of his engine and boilers, but to be somewhat of an electrician as well. Many times he is compelled when he takes a position to run chances of the machinery not getting out of order, and how often is he censured for the apparatus getting out of order when the injunction has been laid against him not to meddle with any portion of the machine or its adjustments. No engineer can take charge of an engine and boiler until he has passed a thorough examination as to his fitness. Still machinery, far more delicate and liable to get out of order is forced upon him. A mischievous person with a little smattering of electricity can give him no end of trouble, when if the engineer thoroughly understands the machinery he could easily locate or determine the cause.

It is not essential that he should cram his head full of the theory of that "mysterious force," but he should endeavor to post himself thoroughly as to the care and running of any electrical apparatus which may be placed under his charge. The modern dynamo is, as a rule, a well built machine, and if proper care be taken should require very little attention; but accidents will happen, and many dollars have been lost through the engineer not knowing what to do in case of an emergency. I will therefore endeavor to give you a few hints as to the care of a dynamo, and an idea of some accidents which are likely to occur, and the best way to look for and repair the same.

To begin with, the position of the dynamo cannot be too well looked after. More often than not, little consequence is attached to this important point, the dynamo being pushed into some dark, out-of-the-way corner, where not only is it next to impossible to see, should anything go wrong, but where it cannot be kept clean. It is most desirable that the position chosen should be in a cool, dry place, free from dust, where the machine can be readily seen and of easy accessibility. This condition is not difficult to fulfill, and the engineer will benefit by it in the end. Plenty of room on all sides should be allowed, as it is not the most pleasant thing in the world to handle in cramped quarters a dynamo which may be running at a high rate of speed and voltage. In choosing a place for a dynamo the switchboard must not be forgotten. It is true that there may be but one switch and fuse block, but it is important to have them where they can both be seen and reached without loss of time. If possible place the switchboard and dynamo where they and the engine can readily be seen from one point, and where in case of emergency, they may be reached with the least possible delay. For instance, if a fuse blows, it ought to be in a position where it would be quickly noticed. The chief object in selecting a place for the dynamo which is free from dust, is that dirt is one of the electrician's greatest enemies, and it can safely be said that over fifty of the so-called diseases of dynamos may be attached to this cause. A dynamo, in fact any kind of electrical apparatus, cannot be kept too clean. In cleaning, not merely a general wiping is necessary, but a thorough inspection of every part, for it is the dirt in the out-of-the-way corners which gives the trouble.

*Commutator.*—In cleaning and inspecting a dynamo, perhaps the most important part to be attended to is the commutator. This, if it has been properly looked after, should have a dark polished surface, and every effort should be made to keep it in this condition. This can only be acquired by cleanliness and proper adjustment and care of the brushes. First—See that no dirt has lodged between the segments, or between the lead wires where they join the commutator bars. A stiff dry brush is useful for this purpose). This is important as many an armature coil has been burned out owing to short-circuiting at the commutator, caused by dirt or copper-dust accumulating at the points mentioned. Secondly—The commutator may be running sparkless and no fear of trouble suggest itself to the engineer; when the machine is stopped, however, careful inspection may show signs of burning along the bars. This should be remedied at once, for if allowed to remain, the result will be badly sparking brushes and development of flats in the commutator. A fine file should be used to smooth the burnt parts, or if too far gone the commutator should be slightly burned down. This latter practice is nearly always necessary in the case of flats It is difficult to explain just how these flats occur; three or four causes are possible: (*a*) One of the bars may be of softer copper than the rest, and so wear away faster; but this is not likely. (*b*) A partial disconnection in the armature at the part connected to

* Paper read at the meeting of Hamilton No. 2 C.A.S.E., Tuesday night, October 12, 1897, by Percy Domville, of the Westinghouse Company, Hamilton, Ont.

the particular flat bar, will cause a spark at every half revolution, so biting away the bar. The trouble in this case will in all probability be found where the lead wires join the commutator. (*c*) Another cause of flats is a badly balanced armature, which, vibrating badly when running, will cause the brushes to jump and spark, burning away one or more of the segments. If the commutator is a new one, particular attention should be paid to keeping the segments firmly held in position. This can be done by tightening the nut or nuts at the end of the commutator. The commutator should be frequently smoothed with fine sandpaper, and oiled until a finely polished surface is obtained.

As before mentioned, the proper adjustment of the brushes plays an important part in the care of the commutator. There is no part of the dynamo that will give the novice more trouble than the brushes, and here again let me impress upon you the importance of cleanliness. A clean well-trimmed brush, properly adjusted in its holder, screwed down to bear against the commutator with just sufficient force to prevent jumping and consequent sparking, and yet not so hard as to cause excessive wear, should give little trouble, provided the commutator is in good condition. See then that each brush is properly trimmed; that is, cut square across, and if copper, filed off at the proper bevel. If carbon, the brushes should first be placed in the brush holders, and a coarse piece of sandpaper inserted between them and the commutator. Then by rocking the rocker arm, the brushes are worn away to the shape of the commutator.

There is no general rule for the thickness of brushes, but one and one half the thickness of the commutator bar is near the mark. The object is to have the brush wide enough to short circuit each section of winding for a brief time, in order that the current may be reversed. The power of the entire machine being dependent of course upon the principle of a rapidly opened and closed circuit creating an induced current, it is much easier to go astray in the thickness of brushes when copper is used, as the angle at which they are set is apt to vary. A very good practice is to make a cross-section of the commutator and brush holder full size in this manner. Then by drawing in the brush, the proper angle can be found, and a piece of wood the shape of the brush can be cut for a template. In adjusting the brushes in the holders, take care that all the leaves, if copper, are in contact the whole width of the brush; if not the result will be a spark, and the longer the machine is allowed to run in this condition the worse it will get This can be prevented by marking the length on your template and making a gauge to set your brushes to. The same care should be taken to see that the brushes bear on precisely opposite bars of the commutator, or, if a four-pole dynamo, that they bear on bars that are a quarter of a circumference apart. A very good way is to mark the commutator bars with a centre punch, so that this adjustment may be verified. Having properly cleaned, trimmed and adjusted the brushes, seeing, of course, that they are all firmly screwed to the holders, they should be raised from the commutator by the hold-off catches and left in this position ready for running.

Outside of the commutator and brushes a general cleaning up is necessary. Remove all traces of dirt from the frame, looking carefully over all insulators of brush holders, binding posts, switches, field coil ends, etc. Also between the armature and pole pieces inside the pulley and around the foundation. Turn the armature round by hand to see that nothing catches and no loose wires or waste are adhering to it, and none of the binding wires are loose. See that the oil cups are full and drip properly. If self-oiling, see that the oil wells are full. Then, seeing that all terminals are screwed down tight, the dynamo is ready to run. Just a word about starting the dynamo. First run your machine with the brushes raised and main switch open, to see that all is right mechanically. Before closing the main switch make sure that the voltage is correct and brushes do not spark. To correct the latter fault, rock the brushes forward or backward till a sparkless place is found; then close the main switch. I might here mention that it is also important to see that all dirt is removed from the switchboard and connections. Examine and clean occasionally the field rheostat contact and contact shoe.

It would take too much time to go into all the details of the mishaps and breakdowns which are likely to happen in the running of a dynamo, but I will mention a few most likely to occur:

*Burning Out of Armatures.*—It is almost impossible to give any definite rules for the prevention of the burning out of armatures, owing to the probable cause of the trouble being difficult to foresee. Still there are a few points which should be remembered in this connection. As before mentioned, short-circuiting at the commutator is one cause. Burning of insulation under the binding-wires will short-circuit the conductors. Short-circuiting in the armature itself is another cause which cannot be foreseen. All that can be done is to let the coil burn out and repair it afterwards. In drum armatures, and in those forms of ring armatures, which are so connected that the windings cross one another, this evil may occur in consequence of the abrasion of the insulation. Short-circuit between an imperfectly insulated wire and the iron core beneath it is again a fruitful source of trouble.

*Field Magnet Coils.*—As a rule field magnet coils give little trouble, but when they do the difficulty is hard to locate, owing to their compactness. Disconnections and short-circuits are most common. When there is a disconnection the machine will probably refuse to excite itself. To make sure, the coils should be disconnected at the ends and tested. A common electric bell will tell you if the wire is continuous. If the wire is broken below the surface, the only way to get at it is to unwind it. A short-circuit between any two of the windings will have the effect of keeping the short-circuiting part cool, whilst the rest is hot. The coil may be short-circuited on the frame, which can be tested with the bell.

*Sparking Brushes.*—Any of the following will cause sparking brushes: Copper or carbon dust between sections of commutator; copper or carbon dust, or oily matter on brush holders, causing leak to frame; open circuit in armature, overload, brushes not at neutral point; brushes covering too many segments; brushes not making good contact or loose in brush-holder; flats in commutator; too weak a field wire of armature touching pole pieces.

A dynamo that has been giving little trouble suddenly ceases to generate. On examination everything is apparently in good order, and yet it is impossible to get a spark from it. First look for an open circuit. This may be done with the electric bell, although it is not always a sure test, as a ring may be obtained when a wire is broken and held together only by insulation. Here dirt may play an important part. Look closely for it under the coupling screws, binding posts, and between the brush-holder and brush-holder rod. A very small particle may be responsible, as the following will show: An arc-lighting dynamo ceased to generate in the manner mentioned. By short-circuiting the brushes it was found possible to obtain a flash, while outside of the brushes this was impossible. It was plain, then, where the trouble lay. The brush-holder had already been examined, but on again looking, one of the insulators was found to be charred close to the rod for about an eighth of an inch. This was caused by dirt lodging between the insulators and brush-holder. It was little, but enough to grind the brush-holder on the frame. Other causes for machines failing to generate are explained as follows: A dynamo standing idle for some time may fail to light when wanted, through a wire in the field circuit being broken and held together only by insulation; or after the connections have been taken apart for the purpose of cleaning and put together again, trouble has been caused through crossing connections to the field. An expert leaves an engineer in charge of an arc machine, and is called back without loss of time, as the machine will not work, and he finds the switch open in the field circuit. When closed, the trouble ceases—in this case the trouble being caused by a matter so trifling as to escape the mind of the instructor.

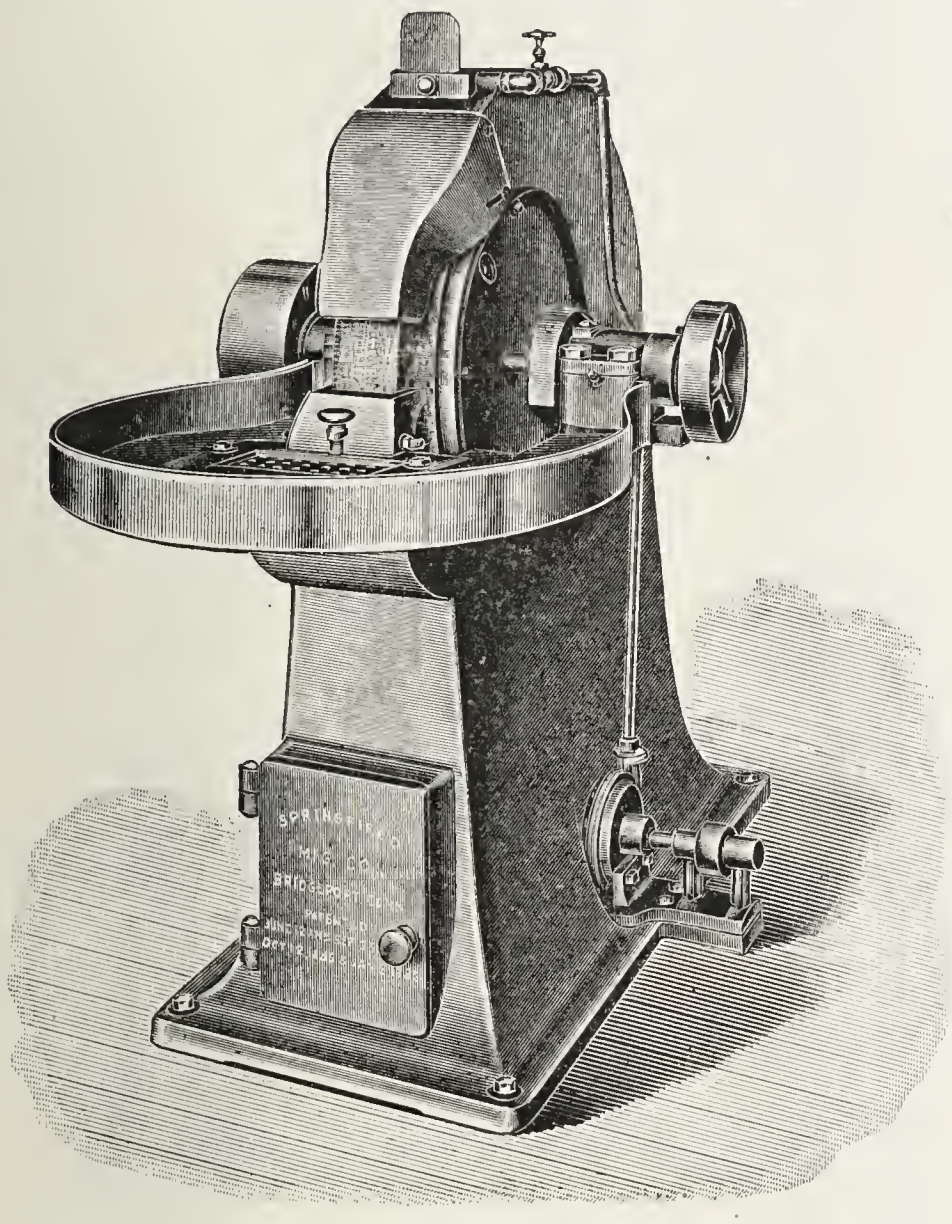
During a thunder storm a flash was noticed at a dynamo, following a vivid flash of lightning, and immediately all lights went out. The dynamo field refused to generate, giving the engineer in charge the mistaken idea that it was burnt out. On investigation it was found that the flash had been caused by one of the binding posts short-circuiting on the frame, the result of lightning striking the line. An engineer after cleaning the brushes of a dynamo could not obtain a spark from it. He had forgotten to screw the lower brushes against the commutator. Another, after hunting for a long time, took the cover off the fuse block and found the fuse blown. These experiences, likely to be met with at any time, with any dynamo, are worth remembering. These are a few of those difficulties which will come to everyone in the responsible position of electrical engineer. There are many points about every machine which should be carefully watched, and faults to be remedied before they become serious There is much than can be gained by experience, but a conscientious worker giving all his mind to his duties, will find himself the gainer, for each day's experience will teach some new point, and what is learned in this way is not soon forgotten.

## THE DAVIS BOILER.

The Davis boiler was fully described in THE CANADIAN ENGINEER for June, 1896. This boiler has been put in several boats, with such results that the builders say there is no better boiler on the market. They are tested to 400 lbs. cold water. The great merit of this boiler over other similar boilers is, that there are pots on both sides of the fire, each pot holding one gallon of water close to the hottest fire. There is a strong prejudice against pipe boilers in Canada; but it is fast disappearing as they become better made and better known. The demand for them is increasing yearly, and the British Government is now using them in naval construction.

## TOOL GRINDER.

The above cut represents a tool grinder using a 36 x 4-inch emery wheel. This machine is used for sharpening tools, and has many advantages over an ordinary grindstone. It occupies less space; the men stand nearer the wheel, and are thus enabled to do better work, the apron being sufficiently large and deep to keep the water from the floor. An iron tank, easily reached, is placed under the wheel to receive the water coming from it and catch the waste ground off, which settles to the bottom, and when sufficient collects the tank can be



quickly emptied. The water overflows from this tank comparatively clean into a second tank, to which a centrifugal pump is attached and piped to carry the water to the wheel, where a valve regulates the flow to the desired amount; the pump, being piped to the latter, leaves the first tank free from pipe connections, so it can be easily handled. This is an important feature. The emery wheel is surrounded by a floating hood, except where the grinding is done, which prevents the water flying off, and is quickly adjusted to the wheel as the latter wears away. Water is carried by a small iron pipe, and evenly distributed on the wheel. Weight of the machine, about 2,250 lbs; height from floor to centre of spindle, 36 inches; length of self-oiling bearings, 8 inches; diameter of spindle, 2¾ inches; spindle pulley, 12 x 5½ inches; floor space, 24 x 48; driving pulley on countershaft, 16 x 5½ inches; speed of emery wheel, 375 to 425 revolutions per minute. Similar machines are manufactured with the following size wheels: 12 x 2; 14 x 2½; 20 x 3; 26 x 4, and 30 x 4. These machines are constructed with safety collars and special wheels with large holes, which make the price of the wheel nearly as cheap as an ordinary grindstone. The Springfield Mfg. Co., Bridgeport, Conn., special tool makers, are the manufacturers of this machine, and will be pleased to furnish further information.

## STREET PAVING IN TORONTO.

The change in the popular mind in regard to paving materials is shown by the rise and fall of the cedar block in Toronto and the present popularity of brick. The city engineer's report, just issued, contains a number of interesting tables. The present percentage of the various classes of pavements is as follows:—

| | Per Cent. |
|---|---|
| Cedar block | 42.23 |
| Stone and scoria | .31 |
| Asphalt | 5.67 |
| Wood on concrete | .21 |
| Macadam | 15.43 |
| Unpaved | 30.98 |
| Cedar block with asphalt between tracks | 2.47 |
| Cedar block with brick between tracks | 1.92 |
| Macadam with stone sets between tracks | .27 |
| Brick on concrete | .51 |
| | 100.00 |
| Total | 257.40 miles. |

In 1881 there were only 116.85 miles of streets in Toronto, and of this total 63.39 miles, or over half, had no pavement of any sort; were, in fact, mud roads. Of the balance 51 miles were macadamized, and only three and a half miles were paved with cedar blocks, the best material then in use, with the exception of a few feet of stone sets laid as an experiment. In 1882 the cedar block craze began, and the mileage of cedar blocked streets rose to 13.41. This was doubled in 1883, and the increase thereafter till 1891 was extraordinarily rapid. Here are the figures of cedar block mileage in use for those years:

| Years. | Miles. |
|---|---|
| 1884 | 33.76 |
| 1885 | 39 84 |
| 1886 | 48.89 |
| 1887 | 64.11 |
| 1888 | 79.55 |
| 1889 | 92.29 |
| 1890 | 109 57 |
| 1891 | 116.83 |
| 1892 | 116.86 |

Between 1883 and 1890 the mileage of macadam was reduced from 54.27 to 36.63, largely by the tearing up of the latter material to make way for a pavement that is neither so healthy nor of such lasting qualities. The failure of cedar was made plain about 1890 and 1891, and since that time, notwithstanding renewals of block pavements on streets where property could not stand a more expensive pavement, the mileage of cedar paved streets in use has fallen. In 1892 it was 116.86, in 1893 112.19, and in 1896 108.70, while this total has been materially reduced during the present paving season. Asphalt was introduced in 1887, when a small strip was laid on Bay street, between Front and King. Jarvis street was paved next year, and the experience was so satisfactory that the asphalt mileage of streets increased from one-quarter of a mile in 1888 to 14.61 miles in 1896. Some of the streets, like Bay and Jarvis, laid almost ten years ago, are still in splendid condition, and will last a long time yet without renewal of the wearing surface. Macadam is again being laid extensively, the mileage having increased from 34.98 in 1893 to 39.71 in 1896. Vitrified brick for paving between the street railway tracks was introduced in 1893, and some five miles of it is now in use. As a material for the full width of the street it was introduced in 1895, and about a mile and a half was in use at the end of 1896. It is now being laid very extensively on gravel foundations on residential streets. The general position of affairs will best be shown by comparing in miles the amount of each of the leading materials in use in five year periods since 1881:—

| | 1881. | 1886. | 1891. | 1896. |
|---|---|---|---|---|
| Cedar | 3.51 | 48.99 | 116.83 | 108.70 |
| Asphalt | .... | .... | 6.66 | 14.61 |
| Macadam | 50 92 | 47.36 | 36.39 | 39.71 |
| Brick | .... | .... | .... | 1.32 |

## AN ISOLATED SEWAGE DISPOSAL PLANT.

*(From a Correspondent.)*

The summer hotel at Penetanguishene is situated on the foreshore of an arm of the Georgian Bay, and is equipped with the latest and best sanitary appliances, including a sewage disposal works, containing several of the latest improvements in the sewage filtration. What these new departures in sewage treatment are, is fully explained in an article on sewage disposal commencing on page 128 of the September number of THE CANADIAN ENGINEER.

I am told that often there are as many as 300 boarders, and when that is the case there will be about 4,500 gallons, or 15 gallons per head, per day, of sewage discharged, 95 per cent. of which will be discharged between the hours of 6 a.m. and 8 p.m. This will make the amount of sludge or settlings in the settling tank about 450 lbs. per day, or 1½ lbs. per head, probably reduced to one-half by decomposition. This will have to be removed, though it is composed of 90 per cent. of water and only 10 per cent. of solids. I propose to describe this Penetanguishene sewage works, because there are in it some points that are unique, as well as efficient in their application, and suitable in our climate for the proper working of the system all the year round, if necessary.

At Penetanguishene, only pure domestic sewage from water-closets, baths, basins and dish water is handled; storm or rain water being very properly excluded. Suitable provision is made to extract the grease from the dish and washing water discharged from the kitchens before it comes to the junction where the waste pipes con-

nect with the main drain. This is a very important and useful arrangement, because grease destroys the efficiency of drains and sewage disposal works. See remarks on the subject of grease, on column two, page 129 of the September number. After the sewage from all parts has been gathered together, it is discharged into a 350-gallon settling tank. (This is somewhat too small for so many people.) This tank has a discharge pipe in the centre, enabling the sludge to be drawn out into a barrel or wagon that may be so constructed that no offensive smell can be observed. When the hotel is working at its full capacity a half ton of sludge may need drawing out every week, but those taking it out can tell best when the thick sludge is drawn off. It is a great detriment to the working of this disposal works that the settling tank is compelled to be so near the house, which causes the paper and excrement from the w. c. to enter it without any chemical change or decomposition having begun, and the process of dissolving paper and excrement into a liquid has to commence in the settling tank, in place of the drains, which is generally done in town's sewage. On sanitary grounds, it would also be unwise to use screens or sieves before entering the tank, because they would catch all the solids just as they are discharged, and the screens would be rapidly choked, and be very offensive to empty and clean.

To overcome this difficulty the whole is allowed to drop into the settling tank, and to prevent it accumulating in one place or becoming a solid mass, a couple of rakes are connected to a central shaft which can be turned round and thus agitate the mass, causing it to more easily dissolve. Of course the stirring should only be done the very last thing of any night, so that the sludge will have time to settle before much of it can overflow into the syphon tank, and never less than four hours prior to opening the valve to run the sludge out, because in that case only very watery sludge could be drawn. From the settling tank the clear sewage is overflowed into a syphon tank which discharges its contents over on to the irrigation filter every time the quantity accumulates to the amount of 400 gallons.

The sewage when discharged from the syphon enters a conduit 87½ feet long which runs the whole length of the irrigation filter, having a branch pipe on each side every two feet, which thoroughly distributes the cleared sewage equally over the surface of the filter. At the bottom of the filter bed there is a similar set of drains to collect the purified effluent and to convey it into the bay. The conduit and distributing pipes are placed about 15 inches below the surface, carefully buried and covered with gravel and sand, the whole topped with sods, which prevents any smell arising, and if the works were used in winter it would also prevent any injury to the filter from severe frosts. A thorough explanation is given in the September article, showing why and how all filters purify sewage; proving that it is not the filtering material that does the purifying alone, but the microbes and bacteria that lodge in it, and that an ample provision of air should always be made to revivify and aerate all filter beds, so that the microbes can secure plenty of oxygen, and discharge the hydrogen they evolve. Particular attention has been given to this requirement at Penetanguishene, and though the surface of the irrigation filter bed is nearly air-tight, or will be when the sods get well knitted, air flues are so arranged that an abundant supply of atmospheric air can be drawn in as needed.

It will be noted that the flushing machinery discharges 400 gallons every 1¼ hours during the day, and nine hours during the night. It will take about thirty minutes for each flushing to pass down through the sand and gravel filter. When passing down and through the filter it is forcing the air the gravel contains downward before it, and a fresh supply of air follows on after the sewage. Thus, the filter is revivified and aerated after each flush, and after each flush it takes a rest for 45 minutes during the day and 8½ hours between each discharge during the night, which should keep the microbes in a healthy condition and ready to do their work. The filter, or what may be properly called an artificial irrigation land filter, is 85 feet by 40 feet, 377 square yards or about 1¼ yards to clean the sewage from each inhabitant when the hotel contains 300 persons, giving about 12 gallons of sewage per yard per day, which is very easy working, and could be more than doubled with safety. The designer of this artificial land filter, and the arrangements for aeration and revivifying the filter are worthy of commendation, but in any future works of the kind it would be wise to give more space for the settling process, and a little improvement in tank arrangements. Whoever brought forth the idea of distributing the sewage on land below the surface, did a great deal toward solving the difficulty of being able to irrigate land with sewage during hard frost, and of preventing offensive smells from such works in hot weather.

I might also state that the Penetanguishene irrigation filter is high and dry above high water mark, even at its lowest point, and can never be waterlogged or drowned and have its efficiency impaired.

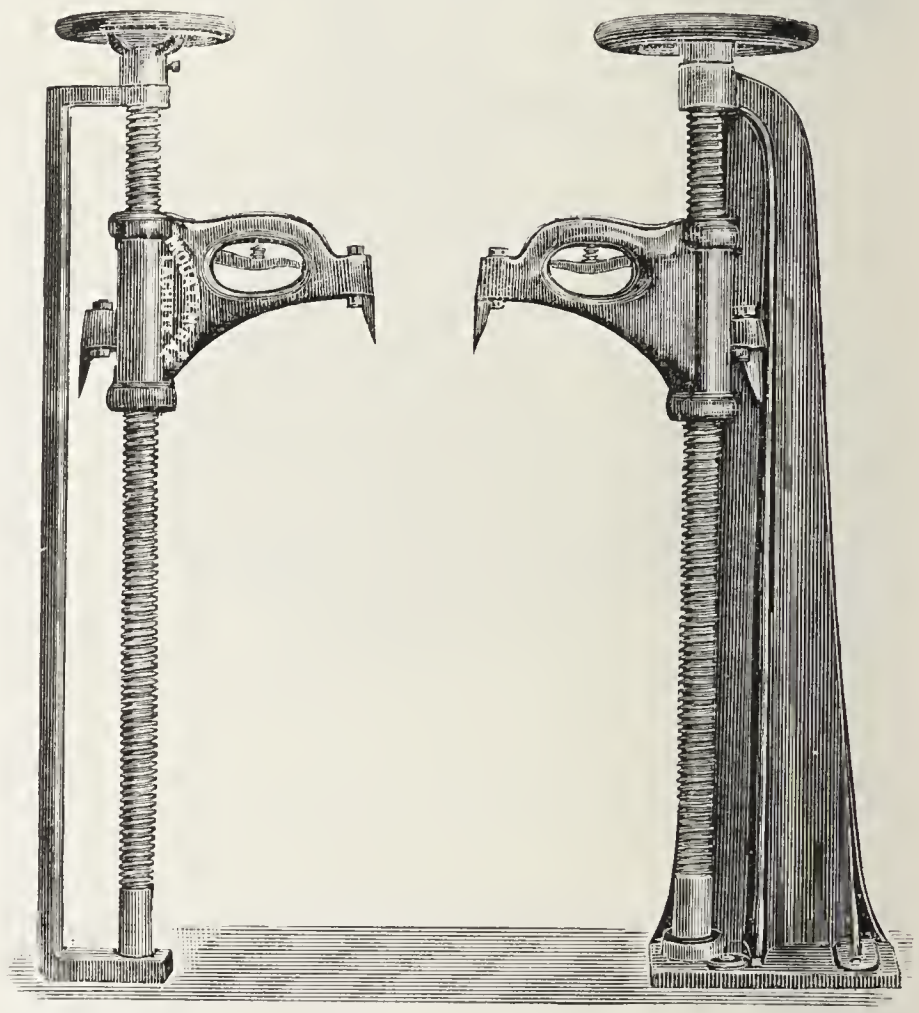
The design and arrangements are a model worth copying by those desiring a sewage system on that principle. At Penetanguishene, the elevation of the hotel being over 20 feet above the water line of the bay, made sewage disposal by irrigation easy; good fall and ventilation could be introduced, but there are few private dwellings or hotels placed in so advantageous a position as this.

The system of distributing the sewage over one foot below the face of the soil was adopted in Great Britain several years ago, for the purpose (so it was stated at the time of introduction), of being able to plough the land without impediment caused by the usual ditches and pipes used to distribute the sewage on top.

Dr. Bryce, Secretary to the Board of Health, in his printed report on the personal inspection of this sewage works at Penetanguishene, dated June 7th, 1897, states that "perhaps the most satisfactory feature of the new improvements is the sewage disposal works. They are an admirable illustration of good engineering and mechanical work applied to carrying out the method of sewage filtration by surface irrigation."

## CLIMAX FROST DOG.

An illustration is given herewith of the Climax Frost Dog, designed and patented by the manufacturers, McOuat & McRae, Lachute, Que This dog weighs enough to drive into a log. By pressing a spring the head is detached from the screw, and its own weight



will send it into position in the log. Then by simply pressing a latch, it is instantly released without the use of a hammer. The advantages of these points are manifest to every sawmill man, and no other frost dog will accomplish these results.

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

The first meeting of the season of the Canadian Society of Civil Engineers, was held Oct. 14th, W. J. Sproule in the chair. The secretary reported a number of applications for admission and for transfer, which had been considered by the council and classified. It was also announced that the society had agreed to lease the new premises from the Bank of Montreal. The discussion on Willis Chipman's paper on the Separate System of Sewerage in Ontario, was then opened, Messrs. Van Buskirk, Ardagh, Bowman and Chipman taking part in the discussion. A paper on Fortifications, by C. R. F. Coutlee, was then read, and an informal discussion on the necessity of military training in our engineering schools was held, after which it was moved by Wm. McNab and seconded by C. H. McLeod, that the thanks of the society be tendered to Mr. Coutlee for his interesting paper on Fortifications. The meeting was then adjourned.

At the meeting of the society on October 28th, J. A Waddell, consulting engineer of the Kansas City, Pittsburgh and Guelph Railway, and permanent engineer of the Omaha Bridge and Tramway Company, gave a lecture on the subject of "Bridges." This was a continuation of the lectures given last year to the students of applied science at McGill University, and all of them are chapters of a book which is to be published next January. We must not forestall the book by quoting

verbatim the really valuable matter which it will contain. In THE CANADIAN ENGINEER of November last, however, we gave a few hints of Mr. Waddell's contentions for greater beauty in construction, and a few specifications of bridges which he had already constructed. The lecture before the Civil Engineers' Society was on "Cantilever Bridges and the Designing of Piers." He objected to the general though false notion that cantilever bridges were always economical, and gave a complete list of the numerous stresses which have to be calculated upon. Instances were found in the bridges either erected or to be erected in Japan by Mr. Waddell. Some advice as to anchorages followed, and then some criticism on the largest cantilever bridges in the world, namely, the Queen's Ferry in Scotland; Lansdowne bridge over the Indus, India; railway bridge at Memphis over the Mississippi, and the Red Rock bridge over the Colorado River. The lecturer then treated of how to design the best piers for different kinds of crossing, and how to proportion them, with criticisms on the cofferdam, pneumatic and open dredging processes. These lectures are taken up largely with elaborate calculations and masses of data, which, when pnblished, will make a most valuable reference book, and probably save days of original figuring to very many bridge designers.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The following is a corrected list of the officers of the C.A.S.E., No. 9, Berlin, Ont.: Wm. Oelschlager, past president; Geo. Steinnetz, president; Job Heyd, vice-president; W. J. Rhodes, secretary; Wm. Tiedt, treasurer; J. L. Bowman, conductor; Agt. Prizgodda, doorkeeper: S. Erglert, A. Arndt, A. Sararas, trustees. Meetings every Friday evening.

Hamilton Association, No. 2, C.A.S.E., are holding open meetings of instruction, two meetings each month, for the fall and winter, to which the public are invited through the press.

The annual dinner of Toronto branch C.A.S.E. will be held on the evening of 24th November at the Richardson House.

Toronto Association of Stationary Engineers is having open meetings on the third Wednesday of each month at its hall, 61 Victoria street, and invites all engineers and manufacturers. This month a lecture on the "Construction of Boilers," by the well-known boiler maker, J. J. Main. All are welcome.

## FIRES OF THE MONTH.

Oct. 4th.—E. C. Squire's cheese factory, Norwood, Ont. Loss on building and machinery, fully insured, $1,200.——Oct. 5th.—Smith & Elford's brick yard, Victoria, B.C., $2,500 damages.——Oct. 7th.—The Edwards Trading Co., Limited, Thurso, Que., lost heavily in the fire at South Indian, Cheney, and Racine, Ont. The total losses amount to about $30,000, a good deal of which was insured. This includes 600 cords of wood at South Indian, 400 cords at Cheney, 100 cords at Racine siding, a sawmill and planing mill and a shingle mill, 3 00,000 feet of lumber, 800,000 shingles. Total insurance $10,000.——Oct. 9th—Dominion Elevator Co.'s elevator, at Bagot, Man.——Oct. 13th—F. J. McManus' sawmill, Bathurst Village, N.B. Loss, about $3,000.—— Oct. 14th—Bleach and Boiler Room of the Northumberland Paper and Electric Co., Campbellford, Ont. Loss was large.——Oct. 14th—Spoolwood mill, at Sugary, N.B.——Oct. 19th—Kingsville, Ont., business block, including A. G. Adams' hardware. Loss, $4,000; H. Scratch, bicycles, $2,500.——Oct. 19th—Philp & Eckhardt's Factory, Esplanade street, Toronto. Loss, $15,000.——Oct. 20th—R. Metzler's Cheese Factory between Violet and Wilton, near Belleville, Ont. Loss, about $6,000.——Oct. 26th—Verity Plow Co., Brantford, Ont. Loss, $25,000.

"THE Electrician" Electrical Trades' Directory and Handbook for 1898 (the big blue book), corrected to January, 1898, containing a very carefully compiled list of British, colonial and foreign electricians, electrical engineers, electric light engineers and contractors, electrical apparatus makers, plant and machinery builders, instrument makers, electric bell makers and fitters, electric light, telegraph and telephone companies, electric light, telegraph and telephone engineers, wire makers and drawers, and of all persons engaged in electrical pursuits throughout the world; useful tables and data relating to electric light and traction, electric power transmission, telegraphs and telephones, electricity supply companies, home and foreign Government departments, etc., etc.; and a biographical section, giving interesting particulars of the careers of about 305 eminent men connected with electricity in all its applications, with many portraits. Full particulars will be sent immediately on application to *The Electrician* office, Salisbury Court, Fleet street, London, E.C. This valuable work will be issued January 1st, 1898.

# Mining Matters.

A STRIKE of gold-bearing rock is reported on the farm of Ira Swayze, a few miles east of Jordan, Ont.

THE Ontario Government is now completing the road into the Saw Bill district as far as Saw Bill Lake.

ROBERT WERDEN, Picton, Ont., has discovered a deposit of tourmalin in one of the northern townships of the county.

THE Harvey Hill Copper Mine, Megantic County, Quebec, has not closed down as was stated in our October number.

THE American Asbestos Company has sold its Black Lake, Que., mine, to L. & E. Wertheim, Frankfort, Germany, for $14,900.

J. C. GARVIN, Denver, Colo., proposes to use a bromide process in treating the black sand in the Saskatchewan, near Edmonton, N.W.T.

THE Toronto Technical School is putting in assay furnaces, intending to give instruction in mining processes during the coming winter.

THE mill at the Golden Cache Mine, B.C., will be run during November, and a clean up made at the end of the month to determine the value of the mine.

E. C. ROSENZI, of the Canadian-American Oil and Natural Gas Co., is preparing to make extensive borings for oil in Ontario, in the neighborhood of Belleville.

THE Rothschilds, of London, England, are reported to have made an offer of two million dollars for the Sultana and Ophir gold mining properties, near Rat Portage, Ont.

E. MCCONNEL has had men recently up above Lake Temiscamingue testing a new find of gold, and has every reason to hope, from tests made, that it will turn out to be a rich find.

THE Ruth mines, Sandon, B.C., will, it is said, put in a concentrator, and the Slocan Star Company has surveyed a site at Cody for one to treat the ore from their Noonday property.

A PLANT has just been installed by the Canadian Rand Drill Co., Montreal, at Bruce Mines, Ontario, and it is hoped that such is an indication of a revival of the mining industry in that section.

J. C. Ross, Pleasant Harbor, N.S., is doing extensive development work on a very promising property, at Tangier, N.S., which was formerly owned by the Pittsburg and Nova Scotia Gold Mining Co.

THE copper-bearing properties in the neighborhood of Kaladar, Ont., are in demand. I. M. McMaster, Rochester, N.Y., is purchasing locations. He has bargained for John A. Carscallen's mine near Flinton, Ont., for $1,500.

THE large compressed air plant, recently installed by the Canadian Rand Drill Co., Montreal, at the new pit of the old Sydney, C.B., mines, has been started and put into service. The machine is of their standard duplex type of the latest pattern.

AT Antigonish, N.S., there has recently arrived a new plant purchased from the Canadian Rand Drill Co. for the Purvis property. The compressor is of the modern duplex type. It is expected that within a few days this will be in active operation.

F. C. INNES, of the Fern mine, Nelson, B.C, stated recently that the new ten-stamp mill was working perfectly, and the percentage of saving and amount of ore treated was greater than calculated upon. The foundation for ten extra stamps is in position.

W. H. MCNEIL, managing director of the Anthracite Coal Company, stated recently that the Canmore, N.W.T., mines are now being opened and turning out 1,000 tons per month, and the capacity of anthracite mines will shortly be 3,000 tons per month.

W. A. FRASER, manager of the Government oil-boring operations at Victoria, N.W.T., has closed operations for the season. A depth of 700 feet has been reached at Victoria, with a slight flow of gas. At Pelican rapids on the Athabasca River there are good indications of oil at 820 feet.

GOLD has been found in paying quantities in the ore dumps of the silver-lead Highlander and Highland mines at Ainsworth, B.C. Maxwell Stevenson, manager of the Highlander, has received returns of $29.70 per ton in gold, from assays made at the United States assay office at Charlotte, N.C.

ONE of the most modern compressors of its size that has ever been in Nova Scotia, was forwarded by the Canadian Rand Drill Co., the other day, to H. H. Fuller & Co., of Halifax. The machine is designed for both mining and high pressures, the air cylinders being compounded and worked in conjunction with an intercooler of the latest type. The heads of the machine were of the hooded type, which renders the compressor in operation practically noiseless.

J. W. Tyrrell, the engineer, Hamilton, Ont., has just returned from the interior of Northern Ontario, east of Lake Winnipeg, which is known as the Lac Seul country, where he has been examining some mining properties for an English company. Gold was found, it is said, in considerable quantities.

A test of the gravel taken up by the dredge employed in clearing out the ground for the middle pier of the bridge, at Edmonton, N.W.T., showed a very large prospect of platinum and a moderate showing of gold. This is said to be the first attempt at prospecting for gold in the bed of the Saskatchewan River.

The large plant which has just been installed by the Canadian Rand Drill Co., Montreal, at the Sultana property, is about ready to start. The mill, which contains 30 stamps, is already in place, and it is expected that the whole will be working very shortly now. Mr. Ross, the local engineer for the Rand drill people, has just returned from there.

There is considerable activity in mining in the neighborhood of Thessalon, Ont. A party of wealthy Americans have bonded one of the large properties and contracted with the Canadian Rand Drill Co., Montreal, to install a complete mining plant. They are going at the matter in earnest and have a large force of men on the ground. The machinery is already there and being set up.

Florence, Middlesex, Ont., is now attracting a great deal of attention as an oil field. The development was only begun in September, but already a very successful well is being pumped, as we show in another column. Very little can be ascertained as to the actual flow at the well, but from the machinery being purchased, and the confident air of the owners, there can be no doubt of the value of the field.

After a great deal of difficulty the heavy compressor and the two immense boilers shipped some time ago by the Canadian Rand Drill Co. to the Foley Mines have arrived in safety. William Brown, erecting engineer for the Rand Co., is hard at work with several gangs of men laying pipe lines and pushing forward to completion the plant, so that it may be started up within a few days now. The compressor is of the modern type, with compound cylinders, condenser, and other modern and economical appliances.

At the Mikado Mine back of Rat Portage, all is activity, and preparations are being made for a new plant, lately contracted for with the Canadian Rand Drill Co., through their Rat Portage engineer, Mr. Ross. The plant is to consist of one of Rand latest type duplex compressors, and with a complete equipment of boilers, air receivers, drills and other accessories. The plant will be shipped within a few days now, and transportation arrangements are being made for its delivery at the mine.

Word has just been received by the Canadian Rand Drill Co., to the effect that the guarantee on the large stamp mill erected at the Crystal Mine has in every way been fulfilled, in fact the machinery throughout has been found to surpass in every way contract specifications. The contract called for a complete equipment, from the supplying of plans for the building, to the starting and operating of the mill for thirty days. Since this a hoisting plant has been ordered and is in daily operation.

While great stories of the Klondyke are abroad, Nova Scotia is not behind. Within the last month large gold finds have been made in various localities. In Guysboro a new find, 17 feet from the surface, gave from one shot $1,000. Capt. William McKenzie, who was down to Renfrew, N.S.. last week, reports a great find, 8 feet from the surface, from 18 buckets of which $6,000 was taken, being the work of only three or four days. Two young men were the lucky finders.—*Colonial Standard, Pictou, N.S.*

At River Herbert, N.S., the annual meeting of the Boston Coal Mining Company (Limited) was held at the mines of the company. The following officers were elected: H. C. Whitney, president; J. Needham, secretary and treasurer; J. E. Blackemore, W. H. Baker and John C. Gordon. The increase of the capital to $1,000,000 was confirmed. The union of the Lawrence and the Victoria areas will give an opportunity to follow the veins of coal worked on the Lawrence area into the Victoria property, which has never been worked.

A recent despatch from Gaspe, Que., stating that the Petroleum Oil Trust Co. had shut down their operations and abandoned their works, was calculated to create the impression that the whole enterprise was a failure. It appears, however, that this is not the case. The Petroleum Oil Trust Co. is an English company, which has expended a large sum of money borrowed in England, France and Belgium, at least $750,000, it is said. What has led to the erroneous impression prevailing on the subject, is the way in which oil boring operations are carried on. The company has sunk a large number of wells on its lots in Gaspe, which represent a superficies of 100,000 square acres, but the borings were stopped the minute the presence of [illegible] e aled.

E. Taillon, Eganville, Ont., has found a silver mine on the Opeongo River.

The latest discovery of gold in Quebec is reported on the farm of Lewis Cuthbertson, Clarendon Front, Pontiac county.

Mining is being somewhat vigorously pushed at Shawville, Que., by a Belgian and American syndicate. A good quality of zinc ore is being taken out.

It is said that J. A. Caldwell the owner of the Sultana mine, Lake of the Woods, Ont., recovered $34,800 in gold by burning the sluices, traps and flooring of the old stamp mill.

A diamond drill has arrived at Dunsinane to bore in the coal mine. If the seam is thick enough to pay for working, the company will start operations soon, as the coal is of very fine quality.—*Sussex, N.B., Record.*

W. H. Wylie, formerly manager of the gold mines at Marmora, Ont., is now the expert of the Great Northern Mining Company, and recently was sent to test a gold field at Lake Wawa, Ont, which assayed $692 to the ton.

The deposits of barytes near Whycocomah, C.B., are attracting considerable attention. This summer we learn that Henderson & Potts, who own several good properties there, have taken out 450 tons for use in the manufacture of paints.

A number of Canadian students are entering the Michigan College of Mines, in spite of the high fees charged non-resident pupils. A matriculation fee of $25 and an annual fee of $150 is now collected. The session of the Michigan Legislature for 1897 changed the name of the Michigan Mining School to that of the Michigan College of Mines.

The Dominion Coal Company has contracted to ship 2,000 tons of duff coal to the Ferrona Iron Works in Pictou county, N.S., for experimental purposes in the manufacture of coke, and particularly to ascertain whether or no the Cape Breton coals contain too much sulphur for this purpose. Dominion, Reserve and Caledonia coals will be used for these experiments.

The River Gilbert in Beauce County, Que., is attracting some notice lately as a gold field. In 1889, the Provincial Mining Engineer Obalski, reported that the quantity of gold in the old bed of the river was $50,000 to $100,000. Hitherto, it is said, the chief difficulty in working the property has been the matter of land titles, but this has been settled by a recent judgment.

The directors of the Crow's Nest Pass Coal Co., capital $100,000, are: Clarkson Jones, F. Wyld, Toronto; G. Gillies, Gananoque, Ont.; Wm. T. Jennings, C.E.; B. Jennings,; Geo. Elliott Casey, Fingal, S. F. McKinnon, W. Mackenzie, J. Flett, J. G. Jones, W. R. Brock, Toronto; C. J. Miles, Hamilton; J. J. Kingsmill, Toronto; D. D. Mann, Montreal; J. Sutherland, Woodstock.

H. N. Kittson, Hamilton, and H. A. Wiley, Port Arthur, about the middle of last month, brought three gold bricks from the Saw Bill mine. The bricks combined weigh 180 ounces and are valued at $3,800. They are the result of the first clean-up at the mine. During the twelve-day run of the mill about 250 tons of ore were crushed, which means that from every ton over $15 has been saved in the batteries, and on the plates. When the concentrates, which are rich, come to be treated, the ore will run at least $17 to the ton. The next clean-up took place about Nov. 1st. The company have already about 2,500 tons of ore on the dump, and between 25,000 and 30,000 tons blocked out in the workings. In other words there is already in sight, at this rate of calculation, nearly $500,000.

## Railway Matters.

The first hundred miles of the Crow's Nest Pass Railway will be completed by December 1st.

T. D. Carroll & Co., have a contract on the Ottawa and New York Railway, at South Finch.

The first rail on the Atlantic and Lake Superior Railway was laid at New Carlisle, Que., October 25th.

The Drummond County Railway was formally opened from St. Hyacinthe to Chaudiere, Que., October 22nd.

Sir Wm. Van Horn recently stated that the C.P.R. would build a line from Robson to Rossland, B.C., 28 miles.

The last rail on the railroad across Newfoundland being built by R. G. Reid, was laid Oct. 2nd, at Port au Basques.

Capt. McMillan, of the steamer "Princess," has accepted a position with the bridge company building the O. & N. Y. Ry. bridge.

The Canadian Pacific Railway has placed two corps of surveyors on the road with a view to open up the Stickeen River route to the Yukon.

C. J. Pusey, president of the Irondale, Bancroft and Ottawa Ralway, has made arrangements by which he will complete an additional five miles of road this fall.

The grades on the Crow's Nest Pass railway in no case will exceed one in one hundred which will make it the easiest crossing of the Rockies in existence.

Alex. McDougall, Arnprior, with a staff of twenty-five men—blacksmiths, clerks, timbermen and teamsters, has a contract on the construction of the Crow's Nest Pass Railway.

Wm. MacKenzie, Toronto, and D. D. Mann, Montreal, have bought the Vancouver, Victoria and Eastern Railway charter. The charter covers the line from Vancouver, through Boundary Creek and Rossland.

The Central Vermont Railway has passed under the control of the Grand Trunk Railway. It comprises about 700 miles of road, from St. Johns, Que., to White River Junction, Vermont, and the line to New London.

Wm. Gibson, Beamsville, Ont., is making rapid progress on the masonry of the reconstructed Victoria Bridge at Montreal. Very little false work has been found necessary, as the materials are run out on cars on a track on top of the covering of the old bridge.

At the semi annual meeting of the stock holders of the Grand Trunk Railroad of Canada, held Oct. 14th, in London, Sir Charles Rivers Wilson, president of the road, congratulated the stockholders on the announcement that the accounts showed a surplus of $13,540.

It is rumored that the C.P.R. is to be extended west from Reston into the Pipestone country. A Souris, Man., correspondent writes that a Government official has been directed to make a thorough inspection of the country west of Reston, and make a report on it.

A new private car for the use of F. H. McGuigan, general superintendent of the Grand Trunk Railway, has been turned out of the company's shops. The car is fitted with all of the latest improvements and is handsomely finished in oak. It will be known as the St. Lawrence.

The Grand Trunk Railway system has added another official to its staff, W. J. Shannon, who for some time past has been travelling over the road instructing the train hands in the proper use of the air brakes. He will be known in the future as the acting air-brake inspector of the entire G.T.R. System.

Angus R. Maclennan has the contract for the grading of the first section north of Cornwall, Ont., on the Ottawa and New York Railway. Green & Butler, of St. Catharines, have the second section, and P. Bonneville, of Lancaster, the third. Charles McGill, Dixons, has a section of the grading. D. R. McDonald, of Williamstown, has taken a contract for twelve miles of the grading north of Crysler.

Engineer L. L. Buck, designer and chief engineer of the new steel arch bridge to replace the suspension bridge at Niagara Falls, says the superstructure will be well under way by November 10th. The false work is almost complete, and the abutments are ready for the superstructure. As mentioned in a recent issue of The Canadian Engineer, it is the intention on the completion of the bridge to take down the old suspension bridge and erect it at Queenston, Ont., thus making a belt line possible on the electric railways.

Amongst the contracts recently taken by Paquet & Fortin, Levis, Que., according to the Quebec *Chronicle*, are a railway branch for the Laurentide Pulp Company a mile and a half in length, and west of the St. Maurice River, which is to be completed at once; a branch of the Great Northern Railway, ten miles in length, to the north of Three Rivers, and a bridge over the Shawenegan River, at five miles and a half from the Grande Mere bridge. It is to be 370 feet in length and 85 feet high. The superstructure is to be of steel, and is being made by the Dominion Bridge Company. They are also building three miles of railway and track to reach the place called Coulee Lavergue, and three miles further up than the Shawenegan River; also a steel bridge 500 feet long and 92 feet high, to be erected over a branch of the Shawenegan. Some 600 men are employed on these works.

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—The largest elevator contract on record is that recently awarded to the Sprague Electric Elevator Co., of New York, by the new Central London Railway, which will run underground through the heart of the great English metropolis. There are to be forty-nine elevators erected in twenty-five different shafts and distributed over six miles of route. The minimum lift will be forty-one feet, and the maximum ninety-one and a half, and they will have an average capacity of one hundred passengers each. This company is represented in Canada by Jack & Robertson, St. Helen street, Montreal.

# Marine News.

The Richelieu & Ontario Navigation Company declared a 3 per cent. half-yearly dividend at a meeting, Oct. 11th.

John White, Arnprior, has launched a boat fitted with a gas engine from the works of J. R. Baird, Woodstock, Ont.

J. H. Wood and S. B. McNeil, Pembroke, Ont., have gone into business as boat builders at Athabasca Landing, N.W.T.

Poole Bros., Yarmouth, N.S, are building a steamer 80 feet keel, 90 feet over all and about 70 tons register. She will be fitted with steeple compound surface condensing engine and steel boiler, by the Burrell-Johnson Co., Yarmouth.

Wm. Thomson & Co., St. John, N.B., have contracted for a new steamer with Russell & Co., of Port Glasgow. This boat will be delivered in January next, and will be about 2,000 tons net register, carrying 5,000 tons dead weight. The boat will be called the "Arbela."

The Bertram Engine Works Company, Limited, has contracts enough on hand to keep it employed for two years, and this press of business expedited the withdrawal of George H. Bertram, president of the company, from the firm of Bertram & Co., hardware merchants.

The Rockland, Me., Shipping Co. has sold the three schooners, "Enterprise," "Emperor," and "Fanny G.," to a syndicate composed of business men of Digby and Yarmouth, N.S. The vessels will be used in the carrying trade between Digby, Yarmouth, Boston and New York.

Louis Coste, Chief Engineer of Public Works, has written to Hon. Robert Watson, Commissioner of Public Works in Manitoba, informing him that tenders will shortly be asked for works designed to lower the waters of Lake Manitoba, a scheme for which Parliament appropriated $25,000 last session.

The side of the Soulanges Canal for a distance of 1,300 feet, and to a depth of 70 feet, fell in recently, carrying with it three large piers and doing damage which may reach $100,000. The accident happened in the night, and there is, therefore, no loss of life. The cave-in happened at what is known as the Raynor section, just above the Coteau du Lac, and at a point where the contractors were at work building a bridge.

The Grand Trunk Railway, with most commendable enterprise, has arranged for a very considerable extension of the tonnage sailing from Portland, Me., in connection with its line. There will be a monthly service between Hamburg and Portland by the Hamburg-American Co., a weekly service to London and a fortnightly service to Bristol and Glasgow. This will make an addition of 60 per cent. to the tonnage serving the G.T.R. at Portland, Me. The service will begin November 15th.

Mr. Lacouture, ex-M.P.P. for Richelieu, has organized two companies for the colonization of the Lake Temiscamingue region. One of the two companies has in view navigation on the lake, and will construct two boats during the winter. The other company has for its object the building of mills and the general development of trade and industry. Mr. Lacouture leaves this evening for the lake with a number of new settlers, several of whom are former Government employees whose services have been dispensed with.

St. John, N.B, papers outline great wharf improvements there to accommodate the C.P.R. The plan deals with what is known as the Long Wharf, and is to extend the present wharf 60 feet south to the harbor line, and carry it back a distance of 700 feet from the southern end, dredging a channel on each side to a depth of 30 feet, making a total of 1,400 feet wharf facing, without including the southern end, which is less than 300 feet long. The tracks to the Union depot are to be moved toward Main street to a point beyond where the wharf is to terminate. The old mill will be torn down and a grain elevator erected in the centre of the wharf. The capacity of this is to be 750,000 bushels.

A new syndicate, with a capital of $30,000, is being formed, it is said, at Montreal for the purpose of purchasing a steamer specially for pilgrimages and excursions. The new boat will have a speed of nineteen or twenty miles an hour. She will be fitted with 128 staterooms, having from two to three berths in each, and will be licensed to carry 800 passengers. The boat will ply to Ste. Anne de Beaupre from Montreal and other points, with pilgrimages and excursions only. It is also said that there will also be another syndicate formed for the purpose of acquiring two steamers to run between Montreal and Quebec to connect with the American line from Lake Ontario, and a new line which is to run on the Saguenay route between Quebec and Lake St. John.

# Electric Flashes.

THE electric railway in Sherbrooke, Que., and Lennoxville, is now completed into the centre of the latter town.

THE Canadian General Electric Company is installing an isolated direct current plant for the Raymond Mfg. Co., Guelph, Ont.

The Valleyfield Electric Company has ordered two 500 light direct current generators from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 60 kilowatt single phase alternating incandescent plant in the town of Magog, Que.

THE Hamilton and Dundas Street Railway has purchased a four motor G. E. 1,000 equipment from the Canadian General Electric Company.

DUCLOS & PAYAN, St. Hyacinthe, have ordered a 200-light, direct current incandescent plant from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 200 light direct current incandescent plant, for the North American Bent Chair Company, Owen Sound, Ont.

THE Lake of the Woods Milling Company, at Keewatin, has ordered a 25 kilowatt, steel frame, multipolar, direct current generator, from the Canadian General Electric Company.

THE Brodie mills at Hespeler, Ont., will be lighted with electricity. The Stevens Manufacturing Co., London, has a contract to install an electric plant of 140 arc lights in the factory.

THERE will be keen competition between Canadian and United States companies to supply the plant for the West India Electric Co., which is to build 25 miles of railway near Kingston, Jamaica.

THE Sarnia Gas and Electric Company is installing a 60 kilowatt Canadian General Electric single phase, standard alternator, to meet the demands of its rapidly increasing incandescent lighting business.

I. J. GOULD, of Uxbridge, Ont., is equipping his plant for the supply of incandescent lighting, and has made a contract with the Canadian General Electric Company for a 30 kilowatt, single phase, alternating plant.

LA CIE ELECTRIC DE ROBERVAL, Chicoutimi County, Quebec, has placed an order with the Canadian General Electric Company, for a 60 kilowatt, single phase alternating machine of the company's standard iron-clad armature, compound type.

THE Strathroy Electric Light Co., Limited, is adding an incandescent lighting equipment to its existing arc lighting plant, and has placed its order with the Canadian General Electric Company for a 30 kilowatt standard, single phase alternator of the company's latest type.

WIARTON is to have incandescent light. Young & Crawford have closed a contract with the Canadian General Electric Company for a 35 kilowatt single phase alternator. Work on the installation of the plant is proceeding rapidly and light will be turned on early this month.

THE S. Morgan Smith Co., York, Pa., has recently been awarded the contract to furnish four McCormick turbines, together with iron cases, feeder pipes, valves, draft tubes, etc. These turbines will operate under 15 feet head in the celebrated electric station of the Niagara Falls Power Co., Niagara Falls, N.Y. It is claimed these are the only turbines of American design which will be used in this plant.

THE Canadian General Electric Company has an order from the Lachine Rapids Hydraulic and Land Company, for their citizens' substation, in Montreal, 2-150 kilowatt revolving field type synchronous motors, each of which is to be direct connected to 2-125 light brush arc machines. The motors will be wound to take three-phase current, at 4,000 volts direct from the primary circuit of the Lachine Company.

THE Willson Carbide Works Company of Merritton, Ont., has recently ordered two additional 150 kilowatt, revolving field, single phase alternators from the Canadian General Electric Company. These machines will be installed in the No. 3 power house, and with the four already in operation, of the same type, will be a total capacity of 900 kilowatts to be used the manufacture of carbide of calcium.

THE Light, Heat and Power Company, of Lindsay, Ont., has added to its incandescent plant a 120 kilowatt standard single phase alternator of the Canadian General Electric Company's latest type, with revolving iron-clad armature, and compounded to secure automatic regulation. The Lindsay company has already a 60 kilowatt and 30 kilowatt machine of the same type in operation for several years past, and with the new apparatus will have ample capacity to supply the incandescent lights, numbering between six and seven thousand, connected to the circuits.

THE Hull electric railway earned $31,000 more this year than last.

IT is said that Brockville, Ont., will have its electric railway next summer.

THE street railway in Kingston, Ont., has done a largely increased business this season.

LINDSAY, ONT., has had an electric fire alarm system installed during the past month.

W. H. SUMMERFELDT & SONS, have made a contract with the council to light the village of Sutton.

THE lighting plant at North Bay is to be improved by the installation of a 150 h.p. engine. A new power house will also be built.

IT is proposd to transform the Kootenay Water Supply Co.'s property at Pend D'Oreille, into an electrical plant to supply power to Rossland, B.C.

JUDGE DOHERTY, of Montreal, adjudged Norbert Lepierre the sum of $1,000, his son having been killed while in the employ of the Light and Power Company, Montreal.

A COMPANY has been organized under President Myles, of the H.G. & B., with a capital of $200,000, to extend the line from Beamsville to St. Catharines, a distance of 12 miles.

A PLAN is mooted to build an electric railway between Woodstock and Ingersoll. Stratford and St. Mary's are also spoken of as an equally good, if not better, field for such an undertaking.

THE London, Ont., Street Railway Company's roadbed and rolling stock have been assessed at $230,000, and the company's taxes will probably be increased $5,000 over last year's figures.

THE Lachine Rapids Land and Power Company has made a contract with the Imperial Electric Light Company, which is situated in the east end of Montreal, whereby the former company will be able to supply power as far east as St. Lawrence street.

IN the case of Mrs. Lang vs. the city of Victoria, which was a suit to recover damages for the death of Lang in the street railway bridge accident a year ago, the jury awarded $22,500, less $2,500 insurance, to Mrs. Lang, the widow to receive $7,500, and each child $2,500.

A number of motormen in Toronto are said to be suffering from a temporary blindness, caused by the reflection of the electric lights within the car being cast on the heavy glass of the vestibule. Some of the men are at present under medical treatment. It is proposed to overcome the difficulty by frosting the door windows.

AT a meeting of the directors of the Ancaster and Chedoke Railway, Oct. 14th, Adam Rutherford announced that he had secured all but $4,000 of the $40,000 necessary for the building of the road. He expressed his confidence of getting this by the quarterly meeting in November. A Hamilton man has promised to build the road if the $40,000 is obtained.

A. J. CORRIVEAU, president of the Electric Belt Line Railway, Montreal, is said to be interested in the projected Montreal Southern Counties Railway. The route embraces St. Johns, St. Alexandre, Bedford, East Stanbridge, Dunham, Cowansville, Sweetsburg, Knowlton, Bolton, Eastman, Magog, thence over Hatley Mountain to North Hatley, Sherbrooke via Capelton and Lennoxville.

JUDGE KENNEY and several other New Yorkers visited Drummondville (Niagara Falls South), to inspect the horse-car railway which connects the three villages of Niagara Falls. The Niagara Falls *Review* says a survey has been made to Lundy's Lane and Falls View, the object being to convert it into an electrical road. The only object now in the way is the source of power, but that, it is believed, will soon be settled.

F. S. BARNARD, managing director of the British Columbia Electric Railway Co., Limited, has on behalf of his company just closed a contract with the Esquimalt Water Works Co., which will supply cheap motive power to Victoria, B.C. A power-house with Pelton water-wheels and generators will be erected at Goldstream, at which point the waterworks company will furnish sufficient water under effective working head to develop electric power. The power will be transmitted a distance of twelve miles to the sub-station of the company in Victoria and there stepped down.

THE past year has been a good one for the Montreal Street Railway Company, as the statement of net earnings for the year ended September 30th, which was issued to-day, shows the total net earnings for the twelve months are $507,885.60. Out of this a 4 per cent. dividend was paid in May last, amounting to $160,000, and another in November of 4 per cent., amounting to $166,666.67. With the latter was a bonus of $41,666.66, making a grand total of $368,-333.33. This leaves a surplus of $139,552 27, which, when added to last year's surplus, gives a total of $340,245.51. During the year the company carried 32,000,000 passengers. What the percentage of operating expenses has been is not as yet given out, but it is expected to be about 55 per cent. of the car earnings. Last year the percentage was 56.48, and in 1895 it was 59.20.

BROCKVILLE, ONT., is agitating for a municipal lighting plant.

THE Canadian General Electric Company is installing a single phase alternating plant for incandescent lighting, for Jacob Morley, of New Hamburg, Ont.

THE capital of the Quebec Electric Street Railway Company is to be increased from $320,000 to $400,000, to permit of the completion of the whole line at once.

THE W. A. Johnson Electric Co., Toronto, have removed from York street to more commodious and centrally situated offices at 134 King street west, near the corner of York street.

THE Sherbrooke, Que., Gas and Water Company has added another 180 K.W. "S.K.C." machine to the plant. It has now two 180 K.W. and two 60 K.W. "S.K.C." machines, from which both light and power are furnished.

THE Teeswater, Ont., Electric Light Co., which has taken over the operation of the waterworks and electric light systems at Teeswater, has decided to install an incandescent electric lighting system, and for this purpose has placed an order with the Royal Electric Co., for one of their 500-light "S.K.C." generators with transformers, etc., the work of installation to begin at once.

JOHN PHILIP, of Grand Valley, Ont., who has heretofore been operating an arc and incandescent electric lighting plant, has decided to go into electric lighting more extensively, and for this purpose has purchased from the Royal Electric Company one of the "S.K.C." two-phase alternating current generators, with 300 light capacity, transformers and supplies. The work of construction is being proceeded with now.

THE Chatham Gas Company, Chatham, Ont., which has been operating an arc and incandescent plant in that town for the last ten years, has decided, owing to the corporation installing a plant and doing the street lighting, to go more extensively into incandescent lighting, and for this purpose has purchased a 2,000 light alternating dynamo from the Royal Electric Company, which is to be installed at once.

THE bankrupt sale of the effects of C. W. Henderson, manufacturer of electrical supplies, Bleury street, Montreal, took place on the 8th October. The electrical supplies were inventoried at $2,639, and were sold at 44 cents on the dollar; the manufactured goods at $981, and sold at 31 cents on the dollar, and the machinery at $801, went at 76 cents on the dollar. The whole lot was bought in by George Climie, acting for parties at present unknown. It is not likely that Mr. Henderson will resume on his own account.

THE Chateauguay & Northern Railway at Montreal is making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. It has ordered the equipment for an electric locomotive from the Canadian General Electric Company, consisting of a four-motor G.E. 1,000 equipment, with four-motor controllers and commutating switches. This outfit, though of less capacity, is similar to the large locomotive recently supplied by the Canadian General Electric Company, to the Hull Electric Company, which has handled as many as thirty-three cars on a shunt.

IN Rutherford v. the H. G. & B Electric Railway Co., a consent judgment was entered after the trial had commenced. The plaintiff, Adam Rutherford, claimed $5,000 damages for alleged wrongful dismissal from the position of secretary-treasurer, and $833 salary in arrears. Mr. Rutherford had been the promoter of the company, and was awarded $2,000 stock in payment of his services, and subsequently engaged as secretary-treasurer at a salary of $800 a year, to date from March 1, 1894. The defence alleged that the grant of stock covered payment for his services until a year later. After a conference between the parties a settlement was arrived at under which Mr. Rutherford received $233 and each side is to pay its own costs.

THE Lachine Rapids Hydraulic and Land Company has ordered from the Canadian General Electric Company two direct connected units for furnishing arc lighting from the citizen's station, from which it is at present supplying some 400 arc lamps, generated from steam power, with small arc machines of the "Wood" and "T-H" type. These new units will consist of synchronous motors of the three-phase, revolving field and stationary armature type, each of which will be direct connected to two 125 light "Brush" arc machines. The motors will be wound to take current at 4,000 volts direct from the primary circuit of the Lachine Company, thus saving the cost and loss in operation entailed by the use of step-down transformers. The motors will be self-starting, and are designed to operate at a very low temperature up to the rated load. The efficiency of the arc plant, operated in this way, should be very high, that of the 125-light "Brush" arc machine being not less than 86 to 88 per cent. at full load.

THE Perth Waterworks Company, Limited, which is installing the waterworks system for Perth, Ont., will use electric power for pumping. The pump house is located within the limits of the town, but the power which they intend using is about four miles away, on the Tay River. Here they are installing a water-wheel and a 200-h.p. generator which will in addition to supplying the power for pumping purposes, furnish light and power. The company has bought out the old Tay Electric Company, and will distribute light and power on the old circuits. The electrical machinery is being installed by the Royal Electric Company, which will use the "S.K.C." two-phase system for this work. The pumping is to be done by means of a 75-h.p. motor belted directly to a triplex double-acting power pump, which pumps directly into the mains, no gravity system or stand-pipe being employed. The mains are equipped with a relief valve so that the pressure can be maintained constant without varying the speed of the pump. The pump is arranged so as to be operated at two different speeds in order to raise the supply of water and the pressure for fire purposes.

THE Cataract Power Co., of Hamilton, having had sufficient stock subscribed to complete their plant, have lost no time in getting down to work. A contract has been let to A. McDonald & Co., of Hamilton, to construct the canal, which will be about 4½ miles long from near Allanburgh to the brow of the "Mountain," not far from DeCew's Falls, where a head of 270 feet will be obtained. The canal will be 30 to 40 feet wide, and 200 to 300 men will be employed in its excavation. The water will be taken from the Welland Canal a short distance above Allanburgh, and the Beaver Dam Creek will be crossed by an aqueduct. The distance from the power-house to the terminus at Hamilton will be 38 miles. This will be the longest electrical transmission line as yet in actual operation, except that of the Blue Lakes Water-Power Co., of California, which transmits power 45 miles. A line is now under construction, however, from the Big Creek Water Co 's plant to San Francisco, by which electrical power will be transmitted a distance of 70 miles, so that the present work will not be phenomenal as to distance. The Cataract Power Co. will have 4,000 horse-power available, and have already closed contracts with a number of corporations and private manufacturing concerns for the supply of power in Hamilton. The principal stockholders in this company are Hamilton men, and it is expected that power will be supplied to the city by the beginning of next May. The contract for the generators, transformers, and all the electrical plant has been let to the Royal Electric Company. A description of this interesting plant will be given in a later issue.

## Personal.

DONALD STEWART, C.E., died at Halifax, October 19th.

J. C. MCNABB, civil engineer, formerly of Chatham, died in Hamilton, Oct. 16th.

BENJAMIN LECKIE, of the G.T.R. shops, Stratford, Ont., has been appointed foreman in the G.T.R. roundhouse at Fort Erie.

THE father of Charles Hays, manager of the Grand Trunk, died in New York a short time ago. Mr. Hays has the sympathy of the public in his bereavement.

W. J. EARLE, C.E., who was engineer in charge of the harbor improvements at St. John, N.B., has taken charge of engineering work on the Crow's Nest Pass Railway.

IN the pulp mills at Milton, Queens county, N.S., a short time ago, Joseph S. Lone, engineer, was caught by a belt and instantly killed. His head was severed from his body.

CARL WEATHERBE, son of Mr. Justice Weatherbe, has been appointed professor of civil engineering and mathematics at King's College, Windsor, N.S., vice Professor Butler.

J. YOUNG HENDERSON, of London, Eng., representing an English pulp manufacturing syndicate, has been in Canada lately, making arrangements for a supply of the higher grades of pulp wood.

SIR CASIMIR CZOWSKI, C.E., went to England last summer to have a surgical operation performed, but returned to his home in Toronto last month, without the hoped-for relief, and is now very ill.

WALTER CHAPMAN, of Barrie, has been made head of the engineering department of the Grand Trunk from Toronto to Nipissing, and all points westward as far as Detroit, with headquarters at Hamilton.

THREE new Governors were appointed at a special meeting of the Board of Governors of McGill University held recently, Sir William C. Van Horne, James Ross, and C. S. Campbell, of Abbott, Campbell & Meredith.

W. J. HAMILTON, a graduate of the Science faculty of McGill University, Montreal, has been for the past two years superintendent of the Philadelphia Smelting and Refining Works, Pueblo, Col. Mr. Hamilton has been sent to Mexico as superintendent of the works of the same company.

STEAMER "Hero," Deseronto, Ont., will have a new boiler put in during the coming winter.

THE Lake Manitoba Railway and Canal Company will probably establish a steamboat service on Lake Winnipegosis.

A. J. Van Nostrand, of Speight & Van Nostrand, surveyors, has returned from his three months field work in the region of the Wabigoon.

THE D.A.R. Co.'s new steamer "Prince Edward," built for the Yarmouth-Boston service by the Earle Shipbuilding and Engineering Co., of Hull, England, is now in service.

HARRY EATON, late foreman of C.P.R. shop No. 1 (Delorimier ave.), Montreal, has been transferred to Farnham, Que. He left Montreal richer by many tangible expressions of friendship.

IN the Dominion Public Works Department, Paul Wetherby, a graduate of the Royal Military College, son of Judge Wetherby, Halifax, will be the chief architect and engineer, assisted by Mr. Mansel.

CHAS. D. MAZE, civil engineer, has entered an action claiming $5,000 damages from David Oppenheimer, for having made a demand of assignment against him, which demand was successfully contested.

H. C. LANDON has resigned as chief engineer of the Chicago, Peoria and St. Louis Railroad to accept a similar position with the New York and Ottawa Railroad, with headquarters at Cornwall, Ont.

CHAS. GURNEY, son of the late Chas. Gurney, founder of the Gurney Stove Manufactory, died at his residence in Hamilton, a short time ago. Deceased had been ill for a long time. Mr. Gurney was a bright business man when in good health, and was a stockholder in the Gurney-Tilden Iron Foundry.

THE friends of William Sadler, son of J. T. Sadler, and nephew of Ald. G. W. Sadler, of Sadler & Haworth, belting manufacturers, will regret to hear that he died recently at his residence, Montreal, after a continued illness. The deceased was formerly a traveller for Sadler & Haworth, and was much esteemed.

DR. BELL, M.D., B.A.Sc., of the Geological Survey of Canada has been elected a Fellow of the Royal Society of Great Britain one of the highest honors attainable by scientists. The vacancies by death in the restricted membership of the Royal Society are few, and the list of scientific men eligible for election is always large.

THIS winter, there will be sailing from St. John, it is said, a weekly service to Liverpool and to London, a ten-day one to Glasgow, and a fortnightly one to Aberdeen and East coast, Scotland, as well as to Belfast and Dublin, and the C.P.R. reports that the outlook for exports through St. John are better this year than ever before.

JAMES MILNE, superintendent of the Toronto Electric Light Co., has resigned his position in that company to take the presidency of the Weeks-Eldred Co., of Toronto, mechanical and sanitary engineers, and manufacturers of the Jones Under-feed Mechanical Stoker. It has not yet been decided who, if anyone, will be Mr. Milne's successor in the electric light company.

GEO. A. RUSSELL, engineer of the Collins Bay Rafting Company's works at the Toronto Island, has, through the instrumentality of H. P. Dwight, chairman of the investigating governors of the Royal Canadian Humane Association, been awarded a medal by that association for his bravery in rescuing from drowning a young lad named Charles Simpson, 10 years of age, on the 9th of June last.

SAMUEL R. CALLAWAY, who has been appointed president of the Lake Shore and Michigan Southern Railway, to succeed the late Daniel W. Caldwell, began his business career with the late Sir Joseph Hickson, then treasurer of the Grand Trunk. He was later with Gilman Cheney in the Canadian Express Company, and went West to take a position on the Great Western with W. K. Muir. He has steadily risen, and now occupies one of the foremost railway positions in America.

ON the occasion of his approaching marriage, the officers of the Richelieu and Ontario Navigation Company met H. Foster Chaffee, district passenger agent of the company, and presented him with a handsome oak cabinet containing a hundred and twenty-five pieces of cutlery, specially imported for the occasion. The presentation was made by C. F. Gildersleeve, the general manager, who explained that the testimonial was a recognition of Mr. Chaffee's merits and the esteem in which he was held by his brother officers.

THE will of the late Mr. Alan Macdougall, C.E., who died in England in April last, has been filed for probate. The estate amounted to $9,400, in addition to some life insurance, and the whole goes to Mrs. Macdougall, to be divided between the two sons, Alan Donald Kenneth and Alan Coursolles Macdougall, and the daughter, Miss Macdougall. In a note Mrs. Macdougall was directed to sell the professional instruments and books, as he did not wish his sons to follow the profession of civil engineer.

WM. T. BONNER, formerly general agent for Canada for the Babcock & Wilcox Company, has recently returned from a trip abroad and will take up his residence in Montreal again, as manager for Canada for the company. Temporary quarters have been taken in the Board of Trade Building, but as soon as the decorators and furnishers can complete their work, the Babcock & Wilcox offices will be located in the Mechanics' Institute Building. A full line of samples and models of the Babcock & Wilcox Company's water tube boilers and accessories will be exhibited. Mr. Bonner has many friends in Canada who will be glad to welcome him back.

# Industrial Notes.

LONEY & MCDONALD have erected a new creamery at Williamstown, Ont.

THE Northern Elevator Co., of Winnipeg, is putting up an elevator at McLean station.

M. SHERIDAN is about to build a sawmill at Aylmer, Que., which is to cost $50,000.

THE towns of Berlin and Waterloo, Ont., will, it is said, build an isolation hospital for their joint use.

IT has been announced that the Lake of the Woods Milling Company will erect an elevator at Qu'Appelle.

BROWN BROS, Welland, Ont., contemplate fitting up a steam plant as auxiliary power to run their flouring mill.

A LARGE and modern cheese and butter factory is in course of erection on the G.T.R. line at Bainsville, Ont.

JAS. SAUNDERS, flour miller, Whitewood, Assa., proposes building an elevator at his mill of 25,000 bushels capacity.

FOUR of the shoe manufacturing firms recently burned out in Quebec intend to resume business before January 1.

WM. BAKER, Arnprior, Ont., has recently supplied 30 car loads of brick to the O.A. & P.S. Ry. at Depot Harbor, Ont.

THE D. Moore Company, Hamilton, Ont., advanced the wages of the moulders in their foundry five per cent., Oct. 16th.

CHAS. FAWCETT, proprietor of the Sackville, N.B., stove foundry, is completing a large stove warehouse. It is 325 ft. long, 95 wide, and with two flats.

THR Downer Pattern Works, Wellington street west, Toronto, was scorched by fire last month, but Mr. Downer announces that his establishment is again in working order, and he is prepared to fill promptly all orders that come in.

JAMES REID, Quebec. has sold the Pont Rouge Pulp Mill to President McDougall, of the Montreal Quarry Company, who is said to represent a syndicate of Montrealers who intend to spend $40,000 to $50,000 on development.

THE Cowichan Lumber Company, Limited, is to be incorporated to do business at Bobcaygeon, Ont. Capital, $150,000. The incorporators are: M. M. Boyd, W. T. C. Boyd, Bobcaygeon; G. Boyd, H. J. Wickham, Toronto; J. D. Flavelle, J. G. Edwards, Lindsay.

THE Minnesota and Winnipeg Lumber Company, a new organization, will build sawmills in Winnipeg shortly. They have purchased timber limits south of Lake of the Woods, and will construct a canal some fourteen miles to connect with the watercourses leading to Winnipeg.

THE Vessot grain grinder, exhibited at the Toronto Exhibition by the manufacturers, S. Vessot & Co., Joliette, Que., attracted much favorable comment, and a large number of orders have been placed in Ontario for this machine, which was awarded the gold medal at the World's Fair, Chicago.

THE Canada Heating and Ventilating Company, Limited, is applying for a Dominion charter to manufacture stoves, ranges, furnaces, etc., in Toronto. The proposed capital is $25,000; the incorporators are: J. McKelvey, S. Birch, Kingston, Ont.; J. T. Johnston, A. F. Webster, and C. W. Kerr, Toronto, Ont.

ATTENTION is called to the announcement in another column of the sale of the Londonderry Iron Co.'s property at Londonderry, N.S Besides 30,000 acres of mineral land, the company have two blast furnaces, two arc kilns, 67 coke ovens, a rolling mill, a pipe foundry and general foundry, machine shop, etc. Further particulars may be had from Macdougall Bros., Montreal.

THE seventh annual meeting of the Association of Architects of the Province of Quebec was held in Quebec recently, and was presided over by A. T. Taylor. There were present J. F. Peachy, A. Raza, A. C. Hutchison, Jos. Venne, S. H. Capper, A. B. Dussault, A. Mailloux, J. Nelson, J. A. Monette, J. P. Ouellet, J. Z. Resther, G. A. Tanguay, M. Perrault, C. Dufort, H. Stavely, D. Oulette and A. H. Larochelle. After the reading of the minutes of the last two sessions and of the annual report by Jos. Venne, the secretary, the election of officers for the ensuing year took place, with the following results: President, J. F. Peachy; vice-presidents, A. Raza, A. F. Dunlop; treasurer, A. Maxwell: secretary, Jos. Venne; council, A. T. Taylor, C. Baillarge, A. C. Hutchison, J. Nelson, O. Mailloux, L. R. Montbriand.

PIPPY & WRIGHT, Revelstoke, B.C., are starting a sash and door factory.

THOS. STEPHENSON, Cannington, Ont., is extending his carriage works.

THE Locked Wire Fence Co., London, Ont., is exporting to Wellington, New Zealand.

THOROLD, ONT., is trying to induce the rubber factory at Port Dalhousie to remove to that town.

ST. JOHN, N.B., will, it is said, float a loan of $125,000, to be applied to the harbor improvements.

THE waterworks plant at Waterloo, Que., has been offered to the municipality by the owners for $21,000.

A BOX factory is to be established at Orillia, Ont., and the corporation will exempt it from taxation for a period of ten years.

MAYOR BREITHAUPT, of Berlin, Ont., is reported to have said that he would not be satisfied till the town bought a steam road roller.

IT is said that the Rathbun Co. will remove its saw mill from Lindsay to Fenelon Falls, Ont., thus saving a considerable sum in towage.

CORNWALL, ONT., which recently returned to Brockville, Ont., the road roller hired from that town, will probably buy one for its own use at an early date.

ONE of the conditions upon which the contract of building the sewers in Nelson was let to E. Bragg, was that he should pay $2.50 per day to his laborers.

THE village of Ashburnham, Ont., is placing a water system chiefly for fire protection, the supply to be taken from the Peterboro waterworks by meter.

THE town council of Welland, Ont., has decided to buy from Goldie & McCulloch, Galt, Ont., two boilers of 40 h.p. each and one 80 h.p. engine for $1,275.

W. H. LEVER, the manufacturer of "Sunlight" soap, will, it is said, establish a large factory in Canada, at Toronto, and another somewhere in the United States.

THE Hon. A. S. White, W. J. Mills and E. A. Charters are a committee to prepare a report on the cost of a sewage system and water supply for Sussex, N.B.

COTE ST. PAUL, near Montreal, is to have both a drainage and light system. It is the intention to complete the drainage first, and work will be proceeded with at once.

THE New Denver, B.C., electric light plant is likely to be so extended as to supply power for pumping the proposed water supply. The town is asked for a bonus of $2,000.

ABRAHAM GOODWIN and John Kerr, Brantford, have bought out the repair department of the A. R. Williams Co.'s machinery agency there, and will operate it on their own account.

LOCAL newspapers in Newfoundland are pleased at the increased prospects of the development of the pulp industry in that colony. Scottish dealers are now said to be entering the market freely.

JNO. MCDOUGALL, Montreal, has the contract for putting in two filters, each of 216,600 gallons capacity per 24 hours, in connection with the Renfrew waterworks plant now being installed. Price, $3,000.

BUDD BROS., Renfrew, Ont, are lighting their premises with acetylene. They have built the isolated stone or brick receptacle outside the building, required by the new regulations of the fire underwriters.

THE Canadian Typograph Co., Windsor, Ont., elected the following officers at the annual meeting: Joseph Taylor, president; F. S. Evans, secretary-treasurer: Cameron Curry and George H. Scripps, directors.

THE Milner-Walker Wagon Company is converting the old sugar refinery in Walkerville, Ont., into a wagon factory. When the change is complete the works in Chatham will be closed and the whole business moved to Walkerville.

THE Hamilton and Toronto Sewer Pipe Co., Hamilton, Ont., has had its assessment fixed by the city council at $8,000 for five years. This amounts to a considerable exemption on the fine new premises the company is building.

THE Sherbrooke Street Railway Co. is using one of the Geo. E. Smith power rail bending machines in the construction of the line. This is a great labor saving machine; being very powerful, it does the work of ten men and has a capacity of one rail per minute.

PORT COLBORNE, Ont., recently sent a committee to Caledonia, N.Y. (a town of 1,200 inhabitants), to report on the waterworks plant there. It was found that the pumping engines were run by natural gas engines, electrically ignited, and the cost of fuel during August was $3.57.

A FARMER'S elevator company is being established at Lumsden, Assa. It is proposed to build a 30,000 bushel elevator.

THE Chicago firm which is manufacturing the three-wheeled "bicycle" is looking for a site for its Canadian factory.

DEYELL & Co., of Souris, have two new elevators under construction, one at Killarney, and the other at Pipestone, Man.

WM. POSTLETHWAITE is making arrangements to build an elevator at Souris, Man., for the syndicate of grain dealers of which he is a member.

THE people of Renfrew have subscribed over $700 to assist W. N. Roberts in rebuilding his wood working factory, burned a short time ago.

PUGSLEY, DINGMAN & Co., Toronto soap manufacturers, are moving to Toronto Junction, exemption from taxes for ten years having been granted.

THE new elevator for the Montreal Transportation Co. at Kingston, Ont., will have two legs and a discharging capacity of 24,000 bushels per hour.

NELSON, BUZZELL & Co., Cowansville, Que., report a very busy season in creamery and cheese factory apparatus, of whose manufacture they make a specialty.

THE S. Morgan Smith Co. has recently shipped to H. Mc. Hart for his pulp mill near Halifax, N.S., a 36 inch horizontal McCormick turbine on horizontal shaft, which will develop 350 h p.

H. W. PETRIE, of Toronto, has sold to George Easterbrook for shipment to Delagoa Bay, South Africa, an engine, with other machinery and supplies, for his flour mills to be erected there.

AT the farm of Mr. Hardiman, three miles from Sault Ste. Marie, a young man, David McGill, was killed and four others seriously injured, by the boiler of a steam thrasher exploding on October 16th

THE work on the new water supply system in St. Hyacinthe, Que., is being pushed to a successful conclusion. The original grant of $35,000 has been found inadequate, and has been increased to $50,000.

THE estate of Alex. Rankine, proprietor of the nut and bolt works, St. John, N.B., who made an assignment early in the year, has been wound up. The creditors were recently paid a dividend of twelve cents on the dollar.

THE city engineer of Toronto has been instructed to report on the purification and disposal of sewage from the Garrison Creek, Rosedale and Don sewers. This is the first step toward the removal of sewage pollution from the bay.

THE tannery owned by A. G. McCrady & Son, Brockville, Ont., which has not been worked for some time, has been started up again, a lot of new machinery supplied by the Lancaster Machine Works of Lancaster, Ont., having been installed therein.

THE cement in use in the new Queen street subway, Toronto, is being supplied by the Owen Sound Portland Cement Co., Limited, Shallow Lake, Ont. This company is preparing to enlarge its output considerably, and is now building four new kilns.

THE description of separate sewage systems for the disposal of surface water and domestic sewage in another part of this paper, is of interest in connection with the report of Willis Chipman on this subject, recently made to the city council of London, Ont.

CHAS. CASSILS has been appointed agent in Montreal for the Carnegie Steel Company, Pittsburg, Pa, producers of rails, angle bars, and other heavy iron work. The trade between the United States and Canada in this class of merchandise is rapidly growing.

THE Wm. Emerson Manufacturing Co., Lawrence, Mass., has concluded arrangements at Granby, Que. The W. Hibbard water power has been secured, and a building 50 by 100 feet, two stories high, is to be erected. The municipality granted exemption from taxation.

EXTENSIVE alterations have been made in and about the G.T.R. depot at Cornwall, Ont. The end of the freight shed has been pierced and a track laid through the same, connecting with the electric street railway, to enable that company to handle the freights for the town and mills.

WM. Harris, Toronto, cattle dealer, has built an abattoir for export business in chilled meats, just to the south of the Toronto cattle market. The building is now nearly ready for occupation, and will, it is understood, be supplied with cold storage apparatus by the Linde British Refrigerator Company.

THE DeLoach Mill Mfg. Co., of Atlanta, Ga., manufacturers of sawmill machinery, hay presses, cane and grinding mills, and the James Ohlew & Sons Saw Mfg. Co., of Columbus, Ohio, have placed the Canadian agency for their products in the hands of the Lancaster Machine Works, Lancaster, Ont.

Some lumbermen are figuring on building a canal from Buffalo Bay, on the Lake of the Woods, to Seine River. There is a fall of three hundred feet and over between these points, and the scheme embraces the floating of logs to Winnipeg to be sawn into lumber from the Lake of the Woods timber limits, the supplying of water from the lower end of the lake to the city, and a water power system.

The gas engine works of J. R. Baird, Woodstock, Ont., are now running overtime. One of Mr. Baird's gasoline engines has been purchased for use at the Royal Military College, Kingston, and one has been bought by the proprietor of the Mitchell *Advocate* to run the presses of that paper, Another Baird engine has been shipped to a Toronto man to operate an isolated electric lighting plant.

George H. Bertram, president of the Bertram Engine works Company, Limited, Toronto, the great steamship and engine builders, and also of the hardware firm of Bertram & Co., has been compelled, owing to the increase of the shipbuilding company's business, to withdraw from the management of the hardware firm. His successor is his son, John H. Bertram, and the style of the firm becomes Bertram, Wilson & Co.

The S. Morgan Smith Co., of York, Pa., has recently shipped to the Acadia Pulp Co., Milton, N.S., a pair of 36-inch McCormick turbines, mounted on horizontal shaft, which, when placed in position, will develop 1,500 h.p. The single 33-inch McCormick turbine, mounted on horizontal shaft, shipped a couple of weeks ago to this same company for the pulp mill in New Germany, is now in operation and has 300 h.p. capacity.

The Tombyll Upholstering and Frame Manufacturing Company Limited, is asking for incorporation, the chief place of business is in the town of St. Henri, Que. The proposed amount of capital is $75,000. The incorporators are: Rasmus Nielson Tombyll, manufacturer, St. Henri; Wm. Henry Turner, Montreal; George H. Labbe, Montreal, manufacturer; Thos. Tombyll, St. Henri, upholsterer; Amedee Anaclet Bernard, of St. Henri, physician.

The evidence in the Sherbrooke Water Works arbitration case has all been submitted, and the commissioners, Wm. Kennedy, C.E., Montreal; B. D. McConnell, Westmount, Que., and E. H. Keating, C.E, Toronto, have made their report. The witnesses on the side of the city were Willis Chipman, C.E., Toronto; Charles Baillairge, C.E, Quebec, and J. A. U. Beaudry, C.E., Montreal; and those for the company were A. Sangster, C.E., superintendent of the works; E. F. Waterhouse, sec.-treas.; S. W. Jenckes, of the Jenckes Machine Co.; R. N. Arkley, millwright, and others. The property included the water power and pumping station land, the reservoir lots, the plant and piping, and the unexpired portion of the contract. The award is for $115,967, of which $21,897.69 is the value of the unexpired contract. Cost of the arbitration, including witness fees, was $2,000

The main power for the Perth, Ont., waterworks is to be brought from a dam four miles up the Tay. John McDougall, Montreal, has been engaged to build the dam and the flume, and to put in the waterwheel and build the power-house. The Royal Electric Company, of Montreal, will put in the electrical plant. From this plant the waterworks company will rent power in town where wanted. The company has arranged to use an island for the reservoir, etc. They will run an open drain from the upper end, 15 feet wide at the top, 10 at the bottom, with a depth of water of 4 feet. At the end there will be a filter-bed. The water thus purified will run into a collecting basin at the end of the filter and enter a fifteen-inch pipe, where it will find its way 1,200 feet under and beside the river channel till it reaches the suction well. The pumping-house, which will be built behind this, will be of brick on stone foundation, 30 x 30 feet. A fifteen-inch main will supply the water from this to the town.

The Recorder of Montreal rendered judgment recently in the case of the City vs. Eusebe Paquette, contractor, for using hollow tile instead of ordinary bricks in the construction of the inner walls of a building. The action was dismissed with costs against the city, the court holding that in the case at issue the wall complained of had been shown to be perfectly safe for the weight it had to bear, while the evidence went to establish that, in case of fire, the tile walls were superior to others, on account of their ability to withstand more heat. The by-law under which the action was taken was one to prevent accidents through defective construction and through fire; the hollow tiles, which were invented only after the passing of this by-law, were proved to be of incombustible material, and to answer both purposes fully. As for the pressure that they could stand, the tests made at McGill College were conclusive, and the court had no hesitation in saying that in the present case, at least, the requirements of the law had been fully met.

A very large number of the employees of the Central Bridge and Engineering Co., Limited, waited upon W. H. Law, the late managing director, at his residence, a short time ago, and presented him with the following address: "*To Wm. H. Law, Esq., C.E.*:— The employees of the Central Bridge and Engineering Company, Limited, upon the severance of your connection with the works desire to avail themselves of this opportunity of expressing to you their keen appreciation of the kindness received from you in the past. Those of us who have been connected with your works since their inception in the town of Peterboro', over fifteen years ago, fully realize the amount of ability and perseverance required to place these works in a position to successfully compete with the long established bridge firms of Canada, and in their own particular line to occupy a place second to none, as shown by the important works recently completed by the company. We join in wishing you and Mrs. Law all possible success and prosperity in the future, and beg that you will accept these slight memorials of our esteem and regard. Signed on behalf of the employees, Geo. Baker, J. Daynard, John Glenn, R. Robson, C. Dawson, A. Craig, Wm. Foster, jr., F. Hamilton, C. Stevens, Thos. Jevons, W. J. Francis. Peterboro', Ont., Aug. 25th, 1897." The mementoes mentioned consisted of a gold watch chain and locket, with monogram, combining the letters, W. H. L., and on the obverse a suitable inscription. The gift to Mrs. Law is a gold ring set with a solitaire diamond. Mr. Law is at present engaged in connection with several patents he holds for England, Canada and the United States.

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A correspondent of an English industrial paper states the case of the employers as against the strikers in the present war in the engineering trade in Great Britain, thus: "The real issue in the present severe struggle in the engineering works of this country has been obscured by irrelevant matter. The cause of the struggle is that the trade unions have interfered in the management of the works by their owners, and have ordered the owners to make serious changes in their management under threat of compelling the workmen to strike. The trade unions have ordered the owners to employ full-priced mechanics to work certain machine-tools that can be worked by junior hands or laborers, and are so worked in other countries. The trade unions have ordered the owners to work each machine-tool by a separate man, instead of one man working two or three machine-tools simultaneously, as is done in other countries. They have ordered that a uniform rate of wages be paid in each trade, for good, bad, or indifferent hands. They have ordered certain men to be discharged from the works because not members of the trade union. They have ordered certain foremen to be discharged, because not under the control of the trade union. They have ordered the speed of turning out work from certain machines to be limited below their full capacity, for the purpose of increasing the number of workmen necessary. They have ordered that one mechanic shall not do any work of another trade, although competent to do it and required to do so for the convenience and expedition of completing the special work in hand. And now the trade unions are wanting to order the owners to pay the workmen nine hours' wages for eight hours' work, and to let their machinery stand idle for the remaining hour of each day."

**KLONDIKE** A mechanical engineer of steady habits and general experience, going to the Klondike in the spring, to take up and work a claim, is desirous of meeting "a mate." References exchanged. Address "BOB," care of Canadian Engineer, Montreal.

**SITUATION WANTED**—Young man, practical machinist, at present engaged in the editorial office of a mechanical newspaper in New York, desires similar position with Canadian publication devoted to the same interests. Stenographer (speed, 150 words per minute) and typewriter. Age 24 years. Address M. C., care Canadian Engineer.

# The Londonderry Iron Company, Limited

THE DIRECTORS of the above company having authorized us to negotiate for the disposal of its extensive properties and works at or near Londonderry, N.S., we are prepared to submit a schedule and to treat with reliable parties. The properties consist of about 30,000 acres of selected mineral lands held in fee simple, free of royalties, besides a further extent of mining rights, two blast furnaces completely equipped, two ore calcining kilns, sixty-seven coke ovens, a large rolling mill, a pipe foundry, a general foundry, a well equipped machine shop, about twelve miles of railway, with four locomotives, cars, etc., etc., numerous houses and all the plants incidental to the production of iron on a large scale.

**MACDOUGALL BROS., Montreal**

# The Canadian Engineer

VOL. V.—No. 8. TORONTO AND MONTREAL, DECEMBER, 1897. PRICE, 10 CENTS $1.00 PER YEAR.

## The Canadian Engineer.

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### CHAP. V.

### ROADBED CONSTRUCTION.

### ART. 15.—WATERWAYS.

The construction engineer, after retracing the centre line, and checking levels, and establishing additional B. M.'s, if necessary, should verify and complete the list of structures fixed upon by the survey party.

The class of structure will depend upon the money and material available, but its cross-section, if it is a waterway, will depend on the *maximum* flow of water it is expected to carry, while if it is a cattle pass or public crossing, its *minimum* dimensions will be fixed by law. Many causes affect the maximum flow of water across a railway roadbed, at a given point, besides the drainage area; in the case of small streams or local watersheds, the building of the roadbed, and consequent roadbed and catch-water ditching, will concentrate the flow, from quite a large area, on a culvert that would naturally have had much less flow to accommodate; this should be anticipated. Then, again, the construction of a railway in a new country will induce such activity as will cause large tracts of forests to be cleared off, and in a few years these cultivated areas will allow storm waters to pass off more rapidly than when the same area was in forest, which should therefore be anticipated and provided for. If the drainage area is in a nearly level country, water will arrive at a given point more gradually than if the slope of the country is abrupt; and also the shape of the drainage area and distribution of tributaries has a marked effect on the maximum flow. If a long stream has few and small branches, the maximum flow will be much less than where there are more and larger tributaries and less main streams, the total area being the same, especially if they empty just above the railway. In this case the flood water from all of them may arrive about the same time. Stony ground, also, sheds water much more rapidly than mellow and highly cultivated ground, and small areas are more liable to *abnormal* floods than large ones, because cloud bursts seldom occupy large tracts of country.

All such considerations should be weighed along with that of acreage, which should be determined, roughly, by personal examination, for every area large or small draining toward and across the railway under construction. There are several empyrical formulæ, purporting to connect the square feet of waterway required with the acreage drained, but they, necessarily, contain a co-efficient which varies with so many causes, such as those just given, as to make them difficult of application, even leaving out of question, the variation in rainfall in different localities. Indeed, it is the greatest rainfall for short periods that is the most important factor, and records of this are usually deficient.

The carrying capacity of a box or arch culvert may be made a maximum by digging straight wide approaches and offtake ditches, and by building flaring wings at each end to avoid contraction, and may be abnormally increased by designing it to carry a head of four or five feet of water in an emergency, which of course, increases the velocity—this, however, is hardly safe practice.

Baker's "Masonry Construction" has these formulæ:

(1) *Myer's.*—Area of waterway in square feet = $C \sqrt[2]{\text{drainage area in acres}}$. In which $C = 1$ for rolling prairie, $1\frac{1}{2}$ for hilly ground, 4 for rocky precipitous ground. This formula, Baker considers, will give too large results for small areas, and too small results for large ones.

(2) *Talbot's.*—Area of waterway in square feet = $C \sqrt[4]{(\text{Drainage area in acres})^3}$. In which, $C = \frac{2}{3}$ to 1 for rocky precipitous ground, $\frac{1}{3}$ for rolling ground, landing floods and snow at same time, and $\frac{1}{5}$ to $\frac{1}{6}$ for long narrow valleys with little or no snow. This formula, used with judgment, will probably give as good results as can be expected, where there are so many varying conditions.

Aside from any data as to acreage, etc., the high water mark at some narrow point in the channel may be noted, information from old residents as to abnormal freshets gathered, the waterway under any existing highway bridges measured, and any other influences noted bearing on the maximum flow, such as the rain records for

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

past years for the nearest weather station, and the probability of the maximum flow being increased by clearing the country, if at present in forest, etc.

It is best to err on the large side, although some engineer has said that if a road has no wash-outs from too small waterways now and then, the structures are too large for ultimate economy.

ART. 16.—STRUCTURES FOR SHALLOW EMBANKMENTS.

The first consideration is to get water across the roadbed and away from it as quickly as possible, this is an axiom of good drainage. To do this where the embankment is from 6 inches to 2 feet deep, and the drainage area only nominal, is often a puzzle. We do not wish to leave an opening in the track, and pipes or stonework are impossible; the usual course is to fill in the pocket above the bank and drain through the track by track boxes (Plate 1, Fig. 20), or where there is from 18 inches to 3 feet of a bank in place of an open culvert which some engineers put in, a plank box (Plate 1, Fig. 21) is preferable, as it can be replaced easily when rotten, will stand the vibration of trains, and does not leave any opening in the track. Sometimes with a very slight drainage area, a blind or French drain is used, which consists of small flat stones placed so as to give a triangular opening of, say 6 inches high x 8 inches wide, but such a waterway is liable to get choked up with leaves, etc., and cannot be depended on indefinitely.

When we come to banks of from 3 feet to 6 feet in depth it is usual to employ iron, terra-cotta or concrete pipes if the waterway is small, and when a heavy flow of water necessitates it, open culverts of from 4 feet to 8 feet span. These latter may be of timber, stone, concrete or brick, but should always be surmounted by an ordinary trestle floor. The use of stringers only is an abomination and a death trap, which should not be tolerated.

*Culvert Pipes.*—The use of double-strength, well-burnt sewer pipe for culverts has increased rapidly of late years in certain sections. They fill a certain want, either where stone is scarce or absent, and at points distant from water or rail communication, as the cost of teaming is small compared with that of iron pipes. In a country subject to severe frost certain precautions must be taken to avoid water settling under or in the pipes, which will crack them in freezing. The grade must be ample, care taken to have the grade convex longitudinally of the pipe, rather than concave, the joints made watertight with cement mortar, and headwalls built at each end with deep aprons, to avoid having any water flow along the pipe outside of it. In southern localities of the United States, America, pipes are used more freely and carelessly, head walls and joint filling are omitted, or only a timber headwall used, but such omissions will invite trouble in Canada.

Again, if the bank is shallow, the same care is hardly necessary in ramming back the filling around the sides of the pipe before loose dumping is commenced as if it is a deep one, but in either case care should always be taken to cut a concave bed for the pipe to rest in and grooves for the spigot joints, or otherwise the load will all come on isolated spots, and the pipe will tend to crack into four segments, bulging out at the sides and down at the crown. If the bottom is solid rock or bouldery, the condition is worse, and breakage can only be avoided by filling in some soft clay well rammed to bed the pipes in, or, better still, to bed the pipe half-way in cheap concrete, as shown on Plate I., Fig. 22. This figure also shows design for a headwall and paving at the lower end. The spigot ends of the sections are always laid up grade. As with other more important structures, pipes should be laid at such a depth that the outlet ditch leads the water to a safe distance with a gentle grade, so as to prevent undermining the lower end.

In place of sewer pipes of clay, there have been isolated attempts at using concrete pipes, but only sporadically. The choice would be entirely a matter of cost. On the other hand, the use of cast-iron culvert pipes is quite common. They can be made up to six or eight feet in diameter, the lengths decreasing as the diameter increases, so as to keep down the weight of a segment. If carefully coated with tar mixture rusting is very slow; and although such pipes are not used often during construction, owing to their great weight, which is against them in hauling by teams, they have a special function which is for use, when their transportation can be by train, in replacing wooden box culverts by drawing through

*Plate. I.* Scale 1 in. = 8 ft

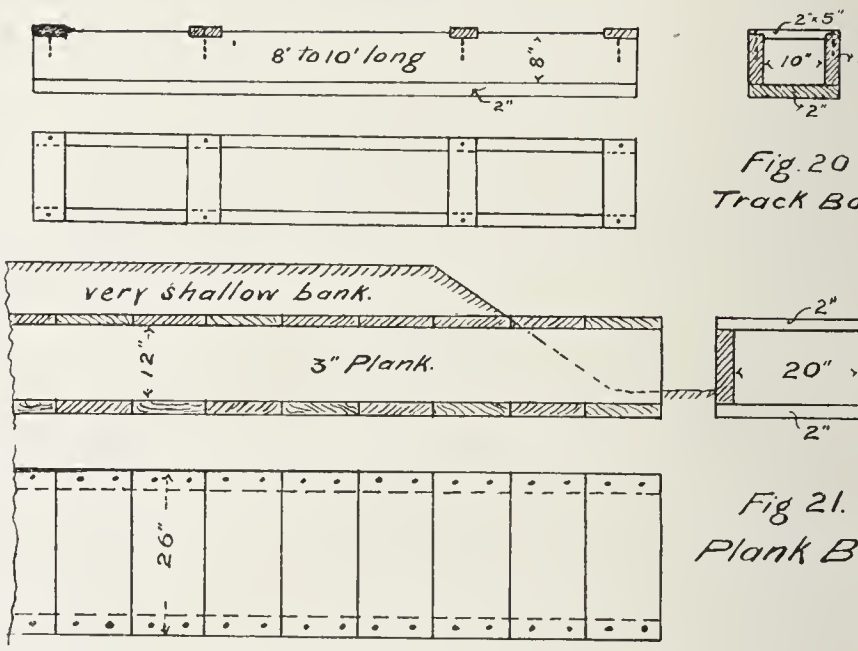



Fig. 20
Track Box.




Fig 21.
Plank Box.

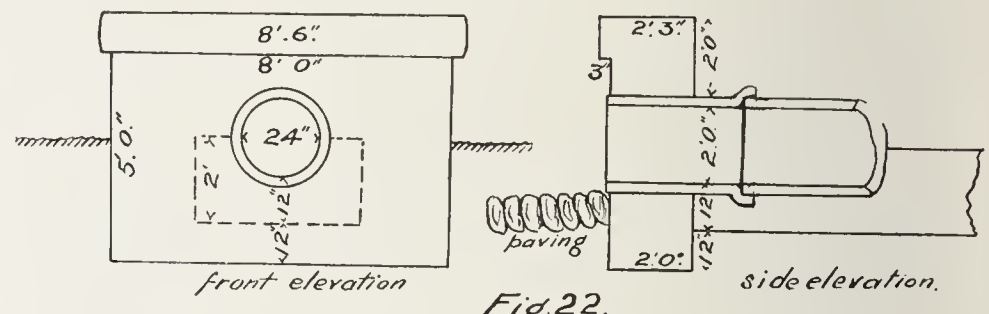
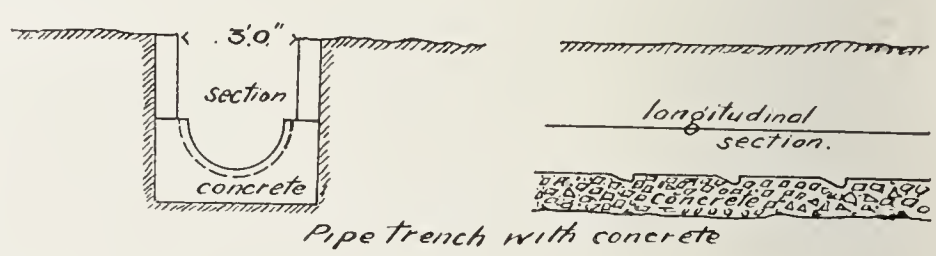



Fig. 22.
Head wall for Iron or Terra-Cotta pipes.




Pipe trench with concrete

when the wooden one is about decayed, and in case this has been anticipated the wooden box culverts will have been made larger than necessary, sufficient to allow of this being done. Cast iron pipes will be laid in the same manner as sewer pipes, except that the joints should in this case be caulked and leaded as with water pipes, although sometimes this is omitted; the cost per foot for cast iron and sewer pipes at the nearest railway depot to the structure will vary somewhat with the locality, but will be approximately as follows:

TABLE XII.

APPROXIMATE COST OF PIPES (NOT INCLUDING LAYING.)

| Diameter. | Sewer Pipe. Cost per foot. | Cast-iron Pipe. Cost per foot. | |
|---|---|---|---|
| 12-inch | 35cts. | $1 15 | This does not include cost of hauling, laying, headwalls or foundations. |
| 18-inch | 70 ". | 1 90 | |
| 2 feet | $1 30 | 3 00 | |
| 3 feet | | 4 80 | |
| 4 feet | | 8 00 | |

The difference of cost, as shown in the table, the less cost of handling and laying of the sewer pipe and its absolute freedom from corrosion will always be greatly in favor of its adoption where well-burnt, salt-glazed, double-strength sewer pipes can be obtained within reasonable length of railroad and team-haul.

*Open Culverts.*—Where a large flow of water is to be carried across a shallow bank some engineers use two or three lines of pipes, but the danger of this method lies in the possibility of debris collecting around the middle walls and gradually choking up the waterway. This can be guarded against by building a screen or paling some distance above the entrance, which catches the debris. Generally speaking, however, a large stream and shallow bank demands an open culvert. In many cases these may answer the double purpose of waterway and cattle guard, or waterway and cattle-pass, for giving passage for cattle under the track. Such structures may be of timber, stone, concrete or brick walls, capped with stone ; but whatever kind may be used, they should be decked with a complete trestle floor, such as to make them safe for derailed trains to pass over. And indeed, latterly, some roads are adopting a solid timber floor, on which the ordinary road ballast is laid, or better still, a floor of discarded steel rails, laid longitudinally, filled in with concrete and covered with ballast ; in either case the roadbed is continuous, and free from danger by derailment or fire, and presents a more elastic and uniform bearing for the track ties.

On Plate II. (Figs. 23 and 24) are shown plans for a 6-foot open culvert of timber or stone. If the bank were deeper, the stone walls would need to be thicker, being designed as level retaining walls, and the timber culvert would need a more thorough system of interior struts, etc., for stability. If the embankment cross-section were to show a rapid descent just at the mouth of the culvert, it would be more economical to place the stepped wings at right angles to the walls, in the form of head walls, about six feet from the centre line. This is not done, ordinarily because less economical, less stable, and subject to vibration and thrust from the train.

The timber open culverts should be well drift-bolted in each course, and have the stringers also notched down slightly and drift-bolted to the walls—the mud sills well sunk into the solid earth, and preferably with paving between them and a sheet piling apron at each end to prevent under-flow and undermining, as shown on Plate IV. (Fig. 28.) If the foundations are not good, a structure, on piles, similar to the one shown on Plate III. (Fig. 25), will need to be used. The earth being retained by a layer of four inches to six inches cedar flatted on three sides, and the two walls held vertical by drift-bolting and notching down the stringers, or if necessary, by additional struts placed from top to top of piles as shown in the figure. The use of high-framed timber openings on mud-sills, lagged behind with cedar like that in Fig. 25 is not advised, they are not stable and are liable to be undermined. Wherever a depth sufficient for cattle passes or farmers' undercrossings is required, it is better to put the structure on well driven piles extending up to grade, if a stone opening cannot be afforded.

The valid objections to open culverts with vertical walls are :

(*a*) That the structure being fixed in elevation, offers a rigid support to the track which, on banks, and on freshly made ones particularly is elastic and settles down for several years, and rises and falls with the frost ; therefore, at such structures there is more or less of a hump, and always a poor piece of track.

(*b*) That in case of the timber culverts, the lagging behind the piles rots quickly, and is rather awkward to replace.

These considerations have led to the use, especially in the southern United States, of a form of structure shown on Plate III. (Fig. 26), which consists of two bents of piles, or two frame bents on pile foundations, with three 15 foot spans of trestle floor, having the two end supports made of mudsills resting well on to the banks. It is probable that 45 feet of trestle floor is not appreciably more dangerous than 15 feet of it, and the only valid objection to this form of structure is that the frost will heave the ends out of surface in climates like that of Canada or the northern United States, but its openness for repairs, the elasticity

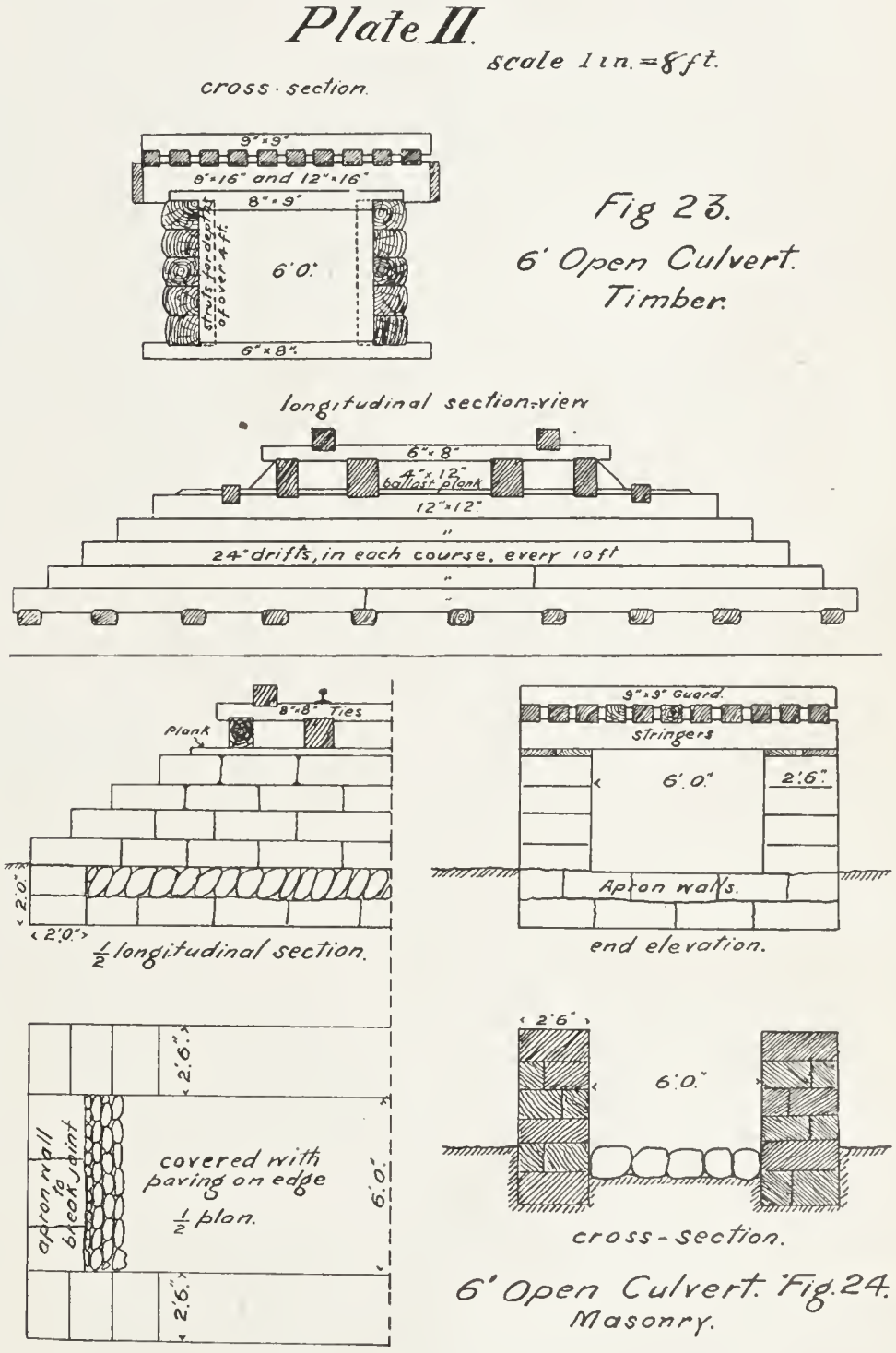



Fig 23.
6' Open Culvert.
Timber.

6' Open Culvert. Fig. 24.
Masonry.

of the ends which rise and fall with the embankments, its freedom from rot, except the easily replaced mudsills, and the possibility of an enlarged waterway by rip-rapping the sloping banks, to allow for an exceptional flood, are all points much in favor of such a structure. This structure is evidently limited to banks less than eight feet high.

The class of masonry for open culvert walls will need to be superior, owing to the effects of vibration from the trains, to avoid part of which oak planks should be placed under the ends of the stringers. The class usually specified is second-class bridge masonry, and will cost from $8 to $10 per cubic yard upward, depending on the quantities in each structure and total quantity in the contract. The economy of rubble concrete walls capped with a stone coping is being now recognised.

The cost of structures of these styles will be approximately as given in Table XIII., taking masonry at $10 per cubic yard, including foundations; paving at $3 per cubic yard; sawn timber at $30 per M.B.M., in place including iron; cedar lagging and timber walls at $25 per M.B.M. in place, and piling at 30 cents per lineal foot, driven, say, 10 feet into the ground.

TABLE XIII.

APPROXIMATE COST OF OPEN CULVERTS.

| Structure. | Height of Waterway. | Clear span in feet being 6 feet. | 8 feet. | 10 feet. | 12 feet. | 15 feet. |
|---|---|---|---|---|---|---|
| | | $ | $ | $ | $ | $ |
| Timber opening. | 4 feet. | 106 | 116 | 126 | 135 | 148 |
| Timber walls. | 6 " | 157 | 167 | 177 | 186 | 201 |
| (Fig. 23.) | 8 " | 212 | 222 | 233 | 243 | 259 |
| Timber opening, | 4 feet. | 110 | 118 | 125 | 133 | 145 |
| piles and lagging. | 6 " | 144 | 152 | 158 | 167 | 179 |
| (Fig. 25.) | 8 " | 168 | 176 | 183 | 191 | 203 |
| Three span. | 4 feet. | | | 170 | 203 | 251 |
| Opening on piles. | 6 " | | | | 208 | 256 |
| (Fig. 26.) | 8 " | | | | | 267 |
| Stone opening. | 4 feet. | 317 | 341 | 365 | 389 | 426 |
| Trestle floor. | 6 " | 457 | 481 | 505 | 529 | 566 |
| (Fig. 24.) | 8 " | 608 | 632 | 656 | 680 | 717 |

From which it is evident that piles with lagging are slightly the cheapest, except with the smallest height and span, and that at 8 feet high and 15 feet span the three-span opening comes to about the same as the other timber structures. The cost of the stone opening is from two to three times as great as the timber ones in first cost, at $10 per cubic yard, but in many cases this could be materially reduced by using concrete at $6 to $8 per cubic yard, at which price a very superior quality can be made even in small quantities. An interesting feature of this table is the deduction that the length of span affects the cost so slightly, it will hardly pay to risk anything in size of waterway for such trifling economies.

### ARTICLE 17.—SMALL WATERWAYS WITH HEAVY EMBANKMENTS.

Under these conditions pipes may still be used, if care is taken in laying them; up to any height, if the waterway is very small; but for cross-section areas of four square feet to twenty square feet, the structure commonly used is the box culvert, which may be made of timber, stone, concrete or brick. The two latter, however, being used, usually, in the arch form, as otherwise stone covers are necessary.

*Timber Box Culverts.*—These are used where cheap structures are desired, or often in undeveloped districts where construction is hurried, timber plentiful, and stone scarce, they should not be put under embankments more than 12 feet to 15 feet high, unless built large enough to admit iron pipes that will carry the rainfall after the timber culvert has begun to decay, which will be in six to twelve years, depending on the timber, etc. If the bank is a shallow one, it will not be very expensive to replace the decayed timber culvert by another similar one, or by a stone box culvert, at a time when stone can be cheaply delivered by rail and the company can afford the outlay, and if the covers are made long, as in Plate IV. (Fig. 27), they will hold up for a year or so after the side timbers have started to rot. Of the two styles shown, the one (Fig. 28) is superior in some respects. It is fastened by iron drift bolts, instead of oak tree nails. It has a row of sheet piling driven at the ends to prevent underflow and undermining, and has solid paving laid between the mud-sills, all of which are distinct improvements. For such structures, probably, cedar is the most durable wood, and pine next. A distinct advantage of timber box culverts is that on soft swampy foundations, all that is necessary is to make a wide solid floor of timber instead of mud-sills, and even lay this floor on several sills running lengthwise of the culvert to distribute the loads over the whole area. Even though some settlement should occur, the elasticity of the timber will save the structure from damage, whereas with a stone or brick culvert any serious settlement means destruction to the masonry.

*Stone Box Culverts.*—Typical plans are given (Figs. 29, 30, 31, 32) on Plates IV. V. and VI. to illustrate essential differences in stone box culverts.

(*a*) Fig. 30, Plate V., shows a solid stone floor under walls and for paving, while the others have the walls independent, which is much preferable because the loads are carried symmetrically to the foundation, *i.e.*, the centres of pressure are opposite the centres of resistance, because the paving may become dislodged without the walls being injured and because the walls may, if desired, be carried lower than the paving, as in Fig. 29.

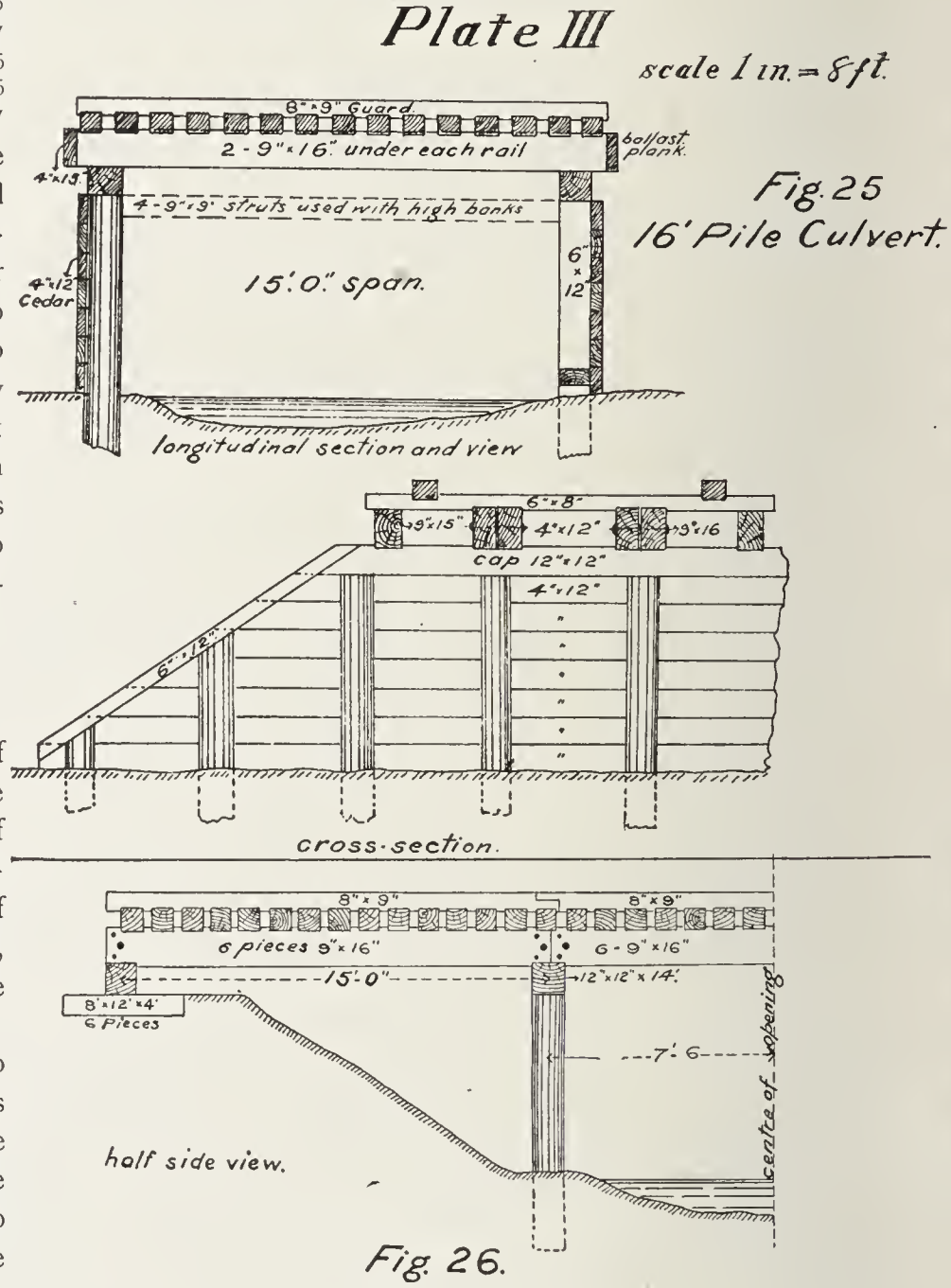



Fig. 25
16' Pile Culvert.

Fig. 26.
Three-span Opening.
(in place of one 15' span pile culvert.)

(*b*) Figs. 30 and 32 show head-walls while the others have straight-stepped wings, the latter is better practice because no amount of sliding or thrusting of any kind from above, can dislodge more than the parapet wall, which is only an ornament, whereas head-walls as in Figs. 30 and 32 can be easily cracked or thrown down by slides in the embankment.

(*c*) Fig. 31 illustrates the use of corbelling where a wide span is required and stone for long, heavy covers is scarce, this method may be developed into a complete gothic.

(*d*) Fig. 29 has a distinctive feature in the *well* formed by the projecting upper wings, which will effectually prevent blocking the mouth with debris, because if any collects here it will merely form a dam, over which the water will pass safely and fall into the well thus formed, whereas

with the other styles shown a complete blockade might occur; this is a matter of importance in wooded countries.

Stone culverts in cold climates are laid in cement mortar, including covers, and the paving is flushed with grout until full; and in all climates apron walls should be sunk two feet to three feet at each end, to prevent leakage along and under the walls and paving, otherwise the action of frost and undermining will both be destructive; but in mild climates such culverts are usually laid dry, and if attention is paid to the bonding and laying, the structure may last indefinitely. This class of work is shown on Fig. 32. Wherever the fall is rapid, paving should be laid beyond the lower end, as in Fig. 30, and may even consist of a very heavy flat stone floor, if the grade of the culvert is excessive. Culverts should, of course, be laid to the natural cross section, no matter how steep—in order to get the outlet low enough to prevent undermining, the direction of the discharging stream, in plan, is immaterial—water will get away somehow, but, in profile, there should never be an increase in the rate of fall, just below the lower end, unless on solid rock. If the foundation bed is solid, the cove which holds up the paving may be left of correct height to carry it, but if the foundation is poor, it will be best to build first a layer of concrete one foot to two feet thick, and commence masonry work and paving on this, or, in case the foundation is always to be under water, a grillage (platform) of timber will be suitable, as in timber box culverts.

Weak foundations are often the cause of failure on stone culverts, and all doubtful ones should be tested by the engineer himself, by driving an iron bar down in several places, but it is best to be on the safe side; a little

Plate IV

scale 1 in.=8 ft.

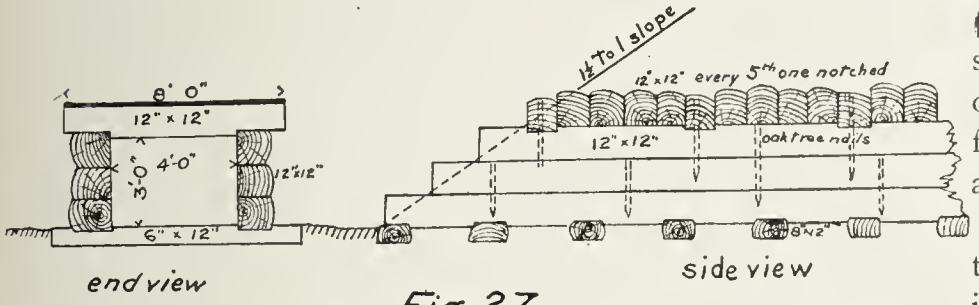



Fig. 27.
3'x4' Timber Culvert.

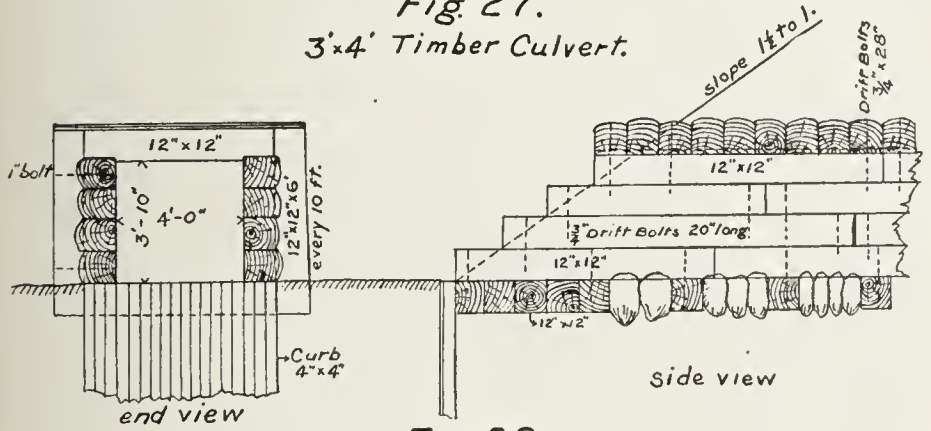



Fig. 28.
4'x4' Timber Culvert.
(C.P.R.)

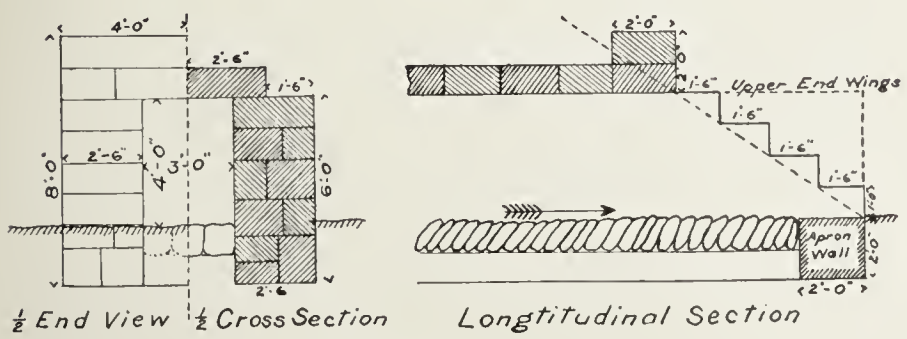



Fig. 29.
3'x4' Masonry Box Culvert.

Plate V.

scale 1 in=8 ft.

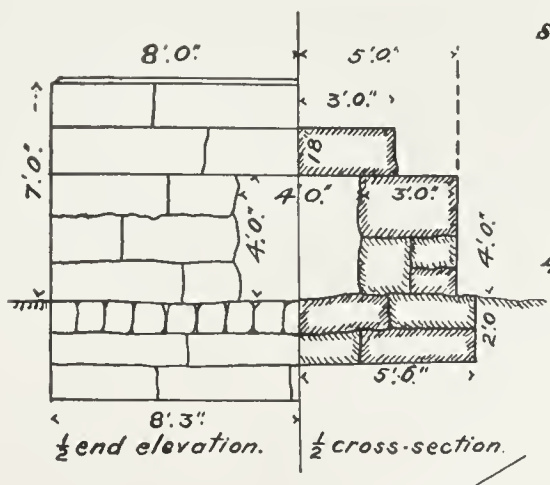
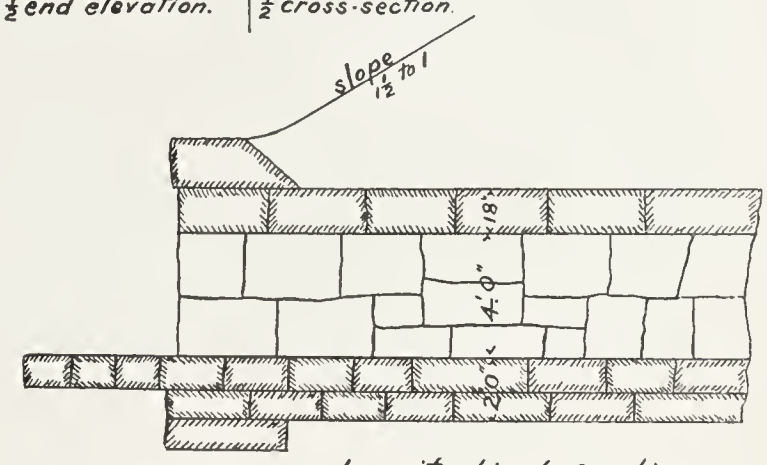
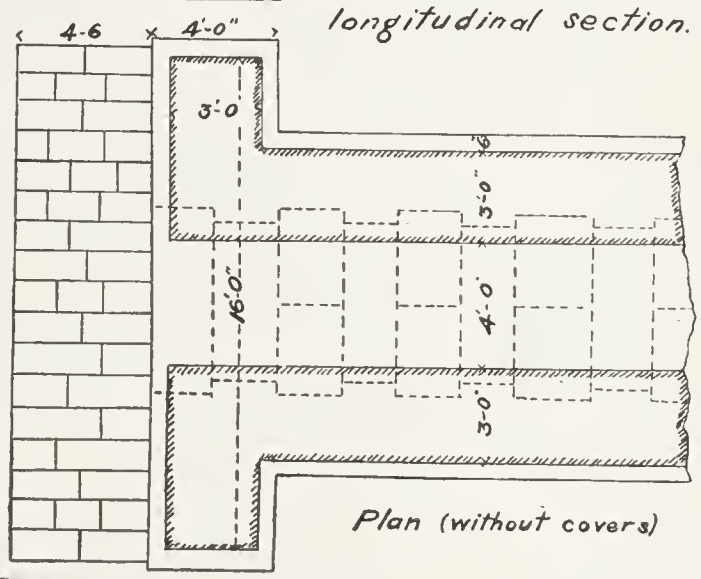



Fig 30.
4'x4' Masonry Box Culvert.




longitudinal section.




Plan (without covers)

sediment on the paving will do no harm, and will be swept out at each storm, whereas if the discharge end is too high, first a hole is worn, and finally the lower end is undermined and falls down.

If possible, culverts should be located at right angles to the centre line, and this can usually be done by diverting the entering stream, and using the material in the embankment adjacent. Skewed structures are expensive in many ways, more particularly, however, with arched culverts. The inspection of stone culverts during construction should be a rigid one, as rascally work can be hidden quicker in this class of masonry than in any other. Especially inspect the covers as to soundness and proper bearing on the walls, which should be from 9 inches on small culverts to 15 inches for large ones; they should have full bearings at each end, and be well spauled and mortared at the joints, to keep out earth and water. In bringing embankments against all culverts, care must be taken not to shove them over; filling should, if possible, be carried on on both sides at the same time, but if not, then earth should be shovelled over, up to the level of the top of the covers, before a high bank is brought forward. These remarks apply more particularly to arched culverts. The use of solid concrete box culverts to take the place of masonry ones is on the increase. They can be built cheaper, and when a knowledge of the science of cements and proper concrete making is more general, such construction will be largely adopted.

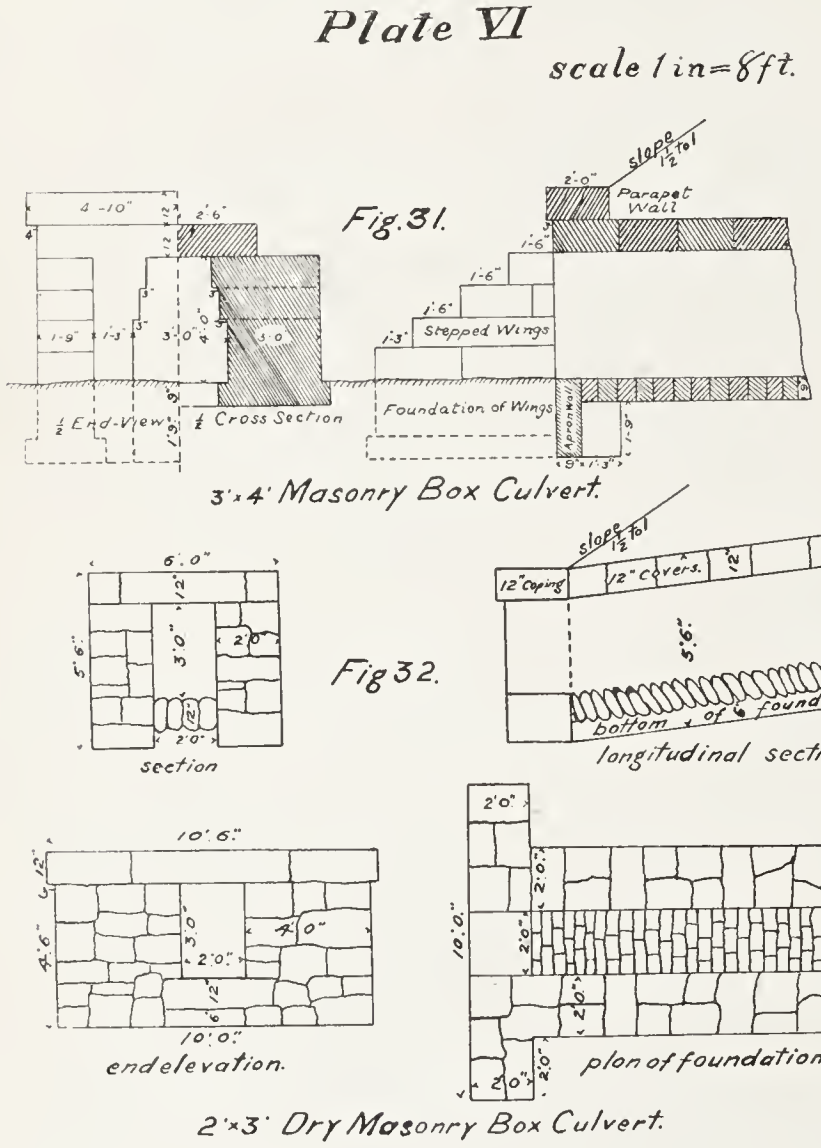
*Specification for Stone Box Culverts laid in mortar.*—"Culvert masonry shall be built of good, sound, large, flat-bedded stones, laid on their natural and horizontal

. The stones used must not be less than three feet in

area of bed, nor less than eight inches thick, and must be hammer-dressed so as to give good beds with half-inch joints or less. Headers shall be built in the wall from front to back, alternately, at least one in every five feet of wall and frequently in the rise of the wall. The least width of bed for stretchers shall be twelve inches. In larger structures, all stones must be heavier in proportion, every attention must be paid to produce good bond, and to give the whole a strong, neat, workmanlike finish. All dimensions must be according to plans, but these may be varied if the engineer so requires."

"The paving shall be of stone set on edge, twelve inches deep, packed solid, of an even face, and inclined in direction of the stream."

"The mortar shall consist of one part good quality Portland cement to three parts of clean sharp sand, and all joints, beds and interstices shall be carefully filled with mortar and packed solid—the exterior faces and interior of barrel shall have all joints raked and pointed with mortar, consisting of one part cement to one part sand."




*Cost of Box Culverts.*—Taking timber in place, including iron and foundations at $25 per M.B.M., culvert masonry at $6 per cubic yard, and paving at $3 per cubic yard, including foundations. The cost of box culverts according to figures (28) timber, and (29) masonry, are given in table XIV.

TABLE XIV.

APPROXIMATE COST OF BOX CULVERTS (16 FOOT EMBANKMENTS).

| Structure. | Waterway. | Total cost for depth of top of paving below subgrade. 10 ft. | 20 ft. | 30 ft. | 40 ft. | 50 ft. | 60 ft. |
|---|---|---|---|---|---|---|---|
| | | $ | $ | $ | $ | $ | $ |
| Timber Box..... Fig. 28. | 2′ x 3′ high | 183 | 306 | 429 | 552 | 675 | 798 |
| " | 3′ x 3′ " | 213 | 356 | 500 | 643 | 787 | 931 |
| " | 3′ x 4′ " | 234 | 397 | 560 | 723 | 886 | 1,049 |
| " | 4′ x 4′ " | 263 | 446 | 629 | 812 | 995 | 1,178 |
| " | 4′ x 5′ " | 281 | 483 | 686 | 888 | 1,091 | 1,294 |
| Stone Box ..... Fig. 29. | 2′ x 3′ " | 254 | 420 | 587 | 754 | 920 | 1,086 |
| " | 3′ x 3′ " | 267 | 444 | 620 | 797 | 974 | 1,151 |
| " | 3′ x 4′ " | 364 | 607 | 851 | 1,094 | 1,338 | 1,582 |
| " | 4′ x 4′ " | 385 | 645 | 905 | 1,165 | 1,425 | 1,685 |
| " | 4′ x 5′ " | 501 | 848 | 1,195 | 1,542 | 1,889 | 2,236 |

From which table it is evident that the stone culverts increase in cost much more rapidly than the timber ones, owing to the necessary increase in the thickness of the stone walls, being estimated at 2 feet, 2½ feet and 3 feet thick for culverts 3 feet, 4 feet and 5 feet high (in the clear) respectively. It does not pay, evidently, to build small timber culverts, other things being equal.

*For* THE CANADIAN ENGINEER.

## THE DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON, TORONTO.

An efficient refuse destructor is a desirable adjunct to the sanitary equipment of towns, and it is cheering to observe that the science of designing and the methods of constructing refuse furnaces has lately made rapid improvements, with the result that any kind of towns' refuse, including excrement, can be quickly and thoroughly burnt without the assistance of fuel. However foul and loathsome the material that is consumed may be, the fumes and smoke will be totally burnt up, instead of being discharged into the atmosphere, which was formerly the rule. A large amount of heat at a temperature of about 2,000° F. is created, which may be used to raise steam for generating electricity for pumping sewage, grinding mortar, crushing stone and clinkers, or any other useful or profitable purpose. Thus ensuring a saving of public health and money.

Some years since Professor Kennedy jokingly asked "How much steam could be raised from a pound of muck," meaning wet filthy refuse, street sweepings, excrements, etc. Geo. Watson, engineer, Leeds, England, and many others have during the past ten years clearly demonstrated that a furnace can be built that will raise one pound of steam for every pound of refuse destroyed, and maintain pressure of 140 pounds.

By studying the laws of creation we find that everything must be active to be useful, and that when activity ceases vitality ceases also, and whether the substance be a living body, or a volume of water, air or gas, when activity stops it becomes offensive and useless. Moreover, every thing created, however mean, small, or repulsive it may appear to us, is for some specific purpose. This is just what is done by gathering up the rejected refuse and filth of towns, and handling them in such a way that the poisonous gases they generate are destroyed and the unhealthy material turned to profitable account.

There are several kinds of refuse. In many towns there are privy pits, or the pail system of water closets, the contents of which have to be disposed of. The scrapings of macadamized roads are suitable only to mix with earth on productive land. Broken glass and crockery can be crushed small and used in place of marble or granite chips for mixing with concrete or asphalt work. Old tin after passing through the fire and the solder has been melted off, can be sold to manufacturing chemists or iron works along with the scrap iron picked out. The brass, copper, lead, and other valuable metals can find a ready and profitable market. Old paper and cotton rags can be easily made into common brown paper by erecting a small mill adjoining the destructor plant, as in Chelsea, Eng., without creating a nuisance, or jeopardizing the public health. The woolen rags may be steamed and afterwards

sold to woolen or shoddy manufacturers. Old boots find a German market, where they are brought to a pulp and molded into trays and fancy ornaments. Old rubbers can be reduced and made over into useful articles. Whole bottles may be cleaned and sold for use. The blood from slaughtered animals can be manufactured into various materials and for several chemical purposes. The fat is rendered into tallow, and the excrements manufactured into a portable inoffensive and valuable manure. The ashes should be sieved through a quarter-inch mesh, and then immersed in water, resieved and the clinkers sorted out, and the residue will then be a fuel almost equal to coal. This goes by the name of washed carbon. The dust dropping through the sieve may be mixed with the contents of privy pits, or the sweepings from paved streets, and sold for manure with the crushed bones. Objectionable material of all kinds that cannot be handled without risk to health, should be consumed in the destructor along with the vegetable and fibrous garbage.

The town council of Cardiff, Wales, has estimated the quantity of each kind of refuse collected in one year, and its selling value in that town :—

| | | | | | |
|---|---|---|---|---|---|
| Broken crockery, 157 long tons, at | 1 | shilling | ..... | £ 7 | 17 0 |
| Scrap iron, 60 long tons, at ..... | 30 | " | ..... | 90 | 0 0 |
| Old tins, 227 long tons, at..... | 20 | " | ..... | 227 | 0 0 |
| Broken glass, 137 long tons, at.... | 30 | " | ..... | 205 | 10 0 |
| Straw and fibrous, 927 long tons, at | 20 | " | ..... | 927 | 0 0 |
| Waste paper, 1,232 long tons, at.. | 40 | " | ..... | 2,464 | 0 0 |
| Rags, 113 long tons, at ..... | 60 | " | ..... | 339 | 0 0 |
| Coal and coke, 240 long tons, at.. | 5 | " | ..... | 60 | 0 0 |
| Small cinders, 18,334 long tons, at | 2½ | " | ..... | 2,291 | 15 0 |
| Fine dust, 5,611 long tons—No value. | | | | | |
| Animal and vegetable refuse made into a special manure, 1,325 tons, at | 20 | " | ..... | 1,325 | 0 0 |
| Bones, 138 tons, at ..... | 75 | " | ..... | 517 | 10 0 |
| Bottles, 12,500 dozen, at 3d. per doz..... | | | ..... | 156 | 5 0 |
| | | | | £8,610 | 17 0 |

In addition to these, there is the heat generated in the destructor furnace, which will raise steam that can be used for power, and is useful in many other ways. The residue from the furnace can be used for building foundations for roads and sidewalks, making cement slabs suitable for paving, etc. ; in fact, everything can be made to serve some useful purpose. Bad meats, fish and flesh of all kinds, can be ground and steam-dried by a revolving machine that reduces it to a fine dry powder, making a fertilizer of great value. All this can be done by experienced workpeople in works situated in the centre of a dense population, without the slightest injury to their health ; but such works would be a danger and a nuisance, besides a bill of costs to the town, if they were not intelligently managed, with strict rules and cleanliness. From the financial side of refuse disposal, there appears to be nothing to hinder towns from paying a considerable amount of their management expenses from the rubbish the inhabitants throw away, and that gathered in the streets.

Along with an engineer, who for twelve years has been in charge of large boilers and engines where the steam is raised from wet sawdust and the bark from wet saw logs, I visited the West and East End Toronto refuse destructors, which, when properly named, are roasting ovens. They are built on the bakers' oven pattern, but in place of the floors being brick, they are covered by a coarse fire grate having an ash-pit underneath. There is one oven about eight yards long and three yards wide erected on each side of the chimney. At the end (and on the same level of each oven) furthest from the chimney, there are three coal furnaces, and either one or two on each side, making at least five in all for each oven. These are fired with coal, the fiery gases from all the furnaces enter the oven and make a bee line to the chimney, keeping the crown of the arch at a blood-red heat during their passage across the length of the oven to the outlet flues. And it is safe to assume that the heat from the coal fire enters the chimney at nearly the same temperature that it leaves the fire, which to my mind is a wilful waste of fuel. Destroying the refuse seems to be a secondary consideration here, and the destructors or ovens are not worked to anywhere near their capacity. They only handle the most inflammable portion of the city's refuse. The workmen say they cannot do more, because the chimneys cannot stand the heat. If this is so, the heat ought to be put to some useful purpose and not wasted in the atmosphere. The workmen might do a fair amount of work and place the garbage in the ovens at periods of not over thirty minutes each, in place of twice or thrice each day, keeping the receptacle nearly full and equally spread over the whole of the fire bars. By charging in that way the top layer would be drying and the bottom would be at a fierce heat, and the ovens would easily carbonize and even burn fierce enough to make clinkers without the aid of the present coal furnaces. Why they use coal can only be answered by assuming that they prefer the expense. When I was at the West End destructor not half the grates were properly covered, and they were broken and out of place, so that there were holes that a boy might creep through, and the whole surroundings were dirty, disorderly and unhealthy. At the East End destructor everything was clean and tidy. There was no reason apparently why it should ever be dirty, for there was very little in the ovens, nothing whatever on the filling floors, and nothing about the place but the attendants, with the doors fastened. If the Toronto destructors are a sample and a precedent for our smaller towns to copy, the consumption of coal will be sure to increase.

There are about five kinds of high-class refuse destructors on the market worthy of notice, each having some good points, and when erected by careful workmen, with good brick and fire-clay, are almost everlasting, and seldom need repairs. When erecting brickwork that will have to resist a fierce heat, the fire-clay mortar should be boiled and used hot, about the thickness of cream, and each brick should be made to fit tight to its neighbor throughout the full width so that a knife blade cannot penetrate. I have seen some of these destructors in working order, and will try and explain them before I finish this subject, but will first explain that simpler methods of disposing of garbage to profit can be used. To my mind the fibrous and vegetable garbage similar to what appears to be burnt in Toronto, and what is necessary to be burnt in most of our small towns, together with bad meat, fish, etc., could be burnt and used in exactly the same way that steam is raised to drive saw-mills by burning the heavy, wet sawdust and log bark, and if garbage is not so inflammable as the wet sawdust, a forced draft could be introduced under the fire-bars that would increase the combustion. It is only a matter of making suitable grate and blast arrangements.

Cook's system is used for destroying the bagasse or refuse from the sugar-cane crushing machines which contains over 60 per cent. of water, 6 per cent. of sugar, and the balance fibrous wood, and the heavy wet sawdust and bark from the cutting of sawlogs direct from the pond, which are little more inflammable, if any, than the light refuse collected from the dust bins of a town, or such garbage and refuse as cannot be used for manure, or roadbeds, or filling useless cavities.

Cook's furnaces which raise steam to run the factories without the use and expense of other fuel are constructed

in the following way: "All the boilers needed are set side by side on the same level, at an elevation sufficient to allow of a deep fire-box and ash-pit, and room enough for an iron barrow to stand under the bottom of the ash-pit doors, all below the bottom of the outer shell of the boiler. In the front of each boiler, a firebrick fire-box is built about four feet square, or six feet long by four feet wide. The grate bars are fixed about four feet below the point where the hot gases leave the vault to pass under the boiler. At the extreme end of the boiler, there is a combustion chamber; from this chamber the heat passes through the tubes in the boiler, after which it passes through and between the economizer or water heater, which supplies the boiler with hot water, then to the chimney, which it reaches at a temperature of about 600° F. I believe with the German scientist Seimens, that if the fire pit be some distance away from the face of the boiler that the fuel will give better results, because it will cause more flue room for the better mixing and combustion of the gases, especially if there are bridges thrown across the flue to break and split up the flames. It would improve the heat still more if a current of heated air could be introduced into the centre of this combustion chamber. It would help to re-burn the moving gases, and increase the heat of the flues. This could be done by carrying an air flue through the centre of the fire box walls. A small 2-inch pipe would do, and it would take sufficient heat from the hot bricks to warm the air passing through. This fire box is extended over four feet above the point where the heated gases leave the fire vault, to pass out towards the boiler. Some of the vaults are covered with heavy iron plates having hinged doors that can be lifted, and a horse cart or railway car load of refuse tipped in at once. However wet the refuse may be, it dries quickly, and the steam it throws off is drawn down and consumed by the fierce heat at the bottom of the fire box, and in the carrying flues, so that before it is lowered down to a point parallel with the boiler flue, it becomes a red burning mass, and another wagon load is tipped in on the top of it. So the process should go on continually night and day when using towns' refuse and garbage.

I have explained this furnace arrangement sufficiently for the reader to understand its advantages, which comes in short to this: that any town can run its own electrical lighting plant, sell electrical power to its manufacturers, pump its supply of water or lift its sewages by erecting suitable plants and using the garbage, refuse and sweepings of the town for fuel, thereby purifying the town's atmosphere, increasing its sanitary qualities, and reducing the sufferings of its inhabitants from disease. The fumes and smoke of the furnace can be completely burnt by having properly arranged flues and secondary combustion chambers, and by using a good steam blast, which, according to Mr. Estcourt's (the public analyst) report, raises the carbonic acid gas from 2 to 14 per cent. The analyst's report of gases generated from rough towns' refuse, including ashes, excrement, sweepings, etc., is carbonic acid 14.6, oxygen 5.4, nitrogen 80.0. The value of coal is about 14.200 units of heat for each pound of coal, which will evaporate 14.70 pounds of water. Two and a-half pounds of dry wood of any kind, of dried bagasse, or dried tanbark, have the same steam-raising quality as one pound of coal. Straw, $3\frac{3}{4}$ pounds; peat, when dry, two pounds, is equal to one pound of coal. I have been told that the horse street railway of Chicago supplied the fuel used for raising steam to run the cable road from the horse litter, with the addition of a small quantity of coal.

The rough wet refuse or garbage collected in towns during wet weather, or excrements mixed with coal ashes or dust and droppings swept from paved streets will contain about 60 to 70 per cent. of moisture, and taking that into consideration, the value of town refuse is about ten pounds of refuse, equal to one pound of coal for steam raising purposes. The total amount of refuse averages about two pounds per head, per day, the year round, equal to seventy-three pounds of coal per head, per year. This, allowing the population of Toronto city to be 190,000, would make the refuse, if burnt in a first-class destructor with the latest designs of steam blowers, equal to 13,870,000 pounds, or 6,935 short tons of coal per year, or 19 tons per day, which is abundance of heat to raise enough steam to pump our water supply, saving the city over $28,000 per year. The pumping station is both a central and suitable place to build a destructor of first-class type, easy to get at; for the carts could go level off the Brock street bridge on to the top of the furnaces to deliver their loads.

*To be continued.*

## REPORT OF THE CANADIAN DEEP WATERWAYS COMMISSION.

The agitation for deep waterways from the Great Lakes to the Atlantic by other than existing routes, has been going on for many years. The first convention to discuss plans of the proposed work was held at Burlington, Vt., in 1849, where it was proposed to connect Lake Champlain with the St. Lawrence by a canal larger than the Chambly. The Caughnawaga Canal was surveyed by the Government some forty years ago, but opposition on the Canadian side, and the fact that no similar outlet existed from Lake Champlain to the Hudson, prevented the construction of this work.

After a dozen conventions had been held, at various United States cities and in the lake region, a Deep Waterways Convention was called by the city of Toronto, in 1894, to which representatives from the United States lake cities were invited. The International Deep Waterways Association was formed, which held its first convention at Cleveland in 1895, and from whose proceedings the Act of Congress creating an International Commission originated.

It is impossible to convey, within reasonable space, an adequate idea of the extraordinary development of inland water transportation on the upper lakes—which, for rapidity, extent, economy and efficiency, has no counterpart even on the ocean. More than half of the best steamships of the United States are imprisoned above Niagara Falls, and more than half of the tonnage built in the United States in 1896 was launched upon the lakes. This inland water commerce has built up twelve cities on the southern shores above Niagara, five of which have over 200,000 population, one over a million, and the remainder above 20,000 each, and within these same limits there are 27 dry docks, the largest of which is on Lake Superior and is 56 feet long, 50 feet wide, with 18 feet water. There are 63 life-saving stations upon these lakes, ten of which are Canadian. Of the 53 United States lake stations, all but five are above Niagara. The economy of this inland water transportation is the result of deep water primarily, and, in the second place, of practically unlimited dimensions in other respects for the vessel; there being but the lift of one lock (of ample dimensions) to reach Lake Superior, and none at all between Buffalo and Chicago.

The large cargo steamers, with triple expansion engines, show a coal consumption (for the best practice) of 2 lbs. per developed horse-power per hour. Actual runs give four-fifths of an ounce of coal per mile consumed per

ton of cargo carried. Economy results from special port facilities, by which loading and also discharging is effected largely by mechanical means. A typical freight steamer is 432 feet over all, 48 feet beam and 28 feet depth (180 feet too long, 4 feet too wide and much too deep for the Welland Canal) and is double bottomed, with compartments into which water ballast can be admitted or pumped out ; with triple expansion engines, cylinders 24, 39 and 63 inches in diameter and 7 feet stroke, supplied from boilers carrying 160 pounds working pressure. It carries over 5,000 gross tons iron ore on 16 feet 10 inches draught of water. The total United States lake feet (including that upon Lake Champlain) in June, 1896, was nearly 3,000 vessels of about 1,300,000 registered tonnage, over 1,800 of which are steamers with about one million registered tonnage. There are 300 of these above Niagara (embracing all the finest vessels of the lakes) which are too long to pass the Welland Canal locks. More than half of these are built of steel and iron, and, of the last fifty built, forty-one were of steel and only nine of wood.

The traffic in iron ore is the chief feature of the lake trade. It is estimated that 75,000,000, tons of ore have been transported on the lakes in the past ten years. Sixty per cent. of the iron ore used in the United States is carried on the lakes. The lumber and coal trade come next in volume to the ore trade. Every reduction in transport charges will enormously increase the amount exported Each reduction extends the area of cultivation in those districts (like the Dakotas and the Canadian prairies), which are dependent on the Lake Superior route, and also extends the area of attraction towards the lake route from the more southern districts having a choice of routes to the Atlantic. The unfortunate position which Montrea occupies, owing largely to the shallowness of the present waterways, is shown by this statement from the report. All of Buffalo's ten million barrels of flour came by lake. Of Montreal's million and a half, only 133,000 barrels came by the St. Lawrence, while 267,000 barrels went to Ogdensburg by water. Of the total movement to tide-water of 150,000,000 bushels of wheat and flour, Montreal received about 11 per cent. Of the total movement to tide water of 107,000,000 bushels of corn, Montreal received about 6 per cent. Of the total 19,035,377 barrels of flour received at tide-water, North Atlantic, Montreal received 8 per cent. Buffalo has 52 elevators including transfer and floating ones, 16 million bushels storage capacity, and 6 million bushels elevating capacity in 24 hours. The transfer charges there upon wheat are $1\frac{1}{8}$ cents per bushel, and in New York $1\frac{3}{8}$ cents.

Experience with large vessels on Lake Erie between 1880 and 1890, and up to date, having been to reduce previous rates of freight between Buffalo and Lakes Superior and Michigan, about one-half (representing many millions of dollars saved in transportation charges), has convinced the representatives of the capital engaged in the commerce of the upper lakes, that an extension of deep water to the Atlantic seaboard will effect an annual saving of more millions than will be required to pay the interest on the cost of such a work, great as that may be. It is also evident from the foregoing that such a waterway would only be undertaken upon the best route to New York, and Canada's interest in the question is, whether that will be an international one. There is only one international route possible, says the report, which is that via the St. Lawrence and Lake Champlain, which is also one which permits of the extension of this deep water system to Montreal, and thence to Europe, on the shortest possible line. This fact, together with the consideration that the St. Lawrence-Champlain route gives the greatest extent of wide and deep water, the least mileage of artificial channel, and the minimum of lockage, has given rise to this International Commission. Canada's interest in such a waterway is only second to that of the United States. It would give an opportunity of doing what our canals were intended to do, but have failed to do ; that is, to obtain the maximum amount of the western trade for the St. Lawrence route ; and, in addition, it would afford a most direct navigation upon the largest scale between Montreal (as well as the Ottawa) and Lake Champlain, with its New England frontier, and with the Hudson River and New York, as also the most economical connection possible with Chicago, Duluth, and Fort William, on Lake Superior.

In a preliminary report made to the Government in March, 1896, the commission reported that the canal from Lake Erie to Lake Ontario would be most advantageously built in United States territory, as satisfactory plans could not be prepared for a channel of the contemplated dimensions to follow the summit level of the present Welland Canal. To attempt this, the work would have to be largely done in winter at greatly increased cost, and its execution would interfere with the free working of the existing line of navigation and endanger its structures. It is, therefore, to be presumed that an enlargement necessarily involving such risks would not be sanctioned by the Government.

The series of canals between the Galops Rapids and Lake St. Francis are being built for fourteen foot navigation along the north shore of the river, and are now, as a whole, well advanced towards completion. From his knowledge of the location and construction of these canals, Thos. Monro, C.E., considers it to be quite inadmissible to permit an attempt to be made to deepen them to twenty feet or more, for similar reasons to those above stated in reference to the Welland Canal. A reconnaissance has been made, and a few levels taken serves to indicate that the United States, or south side of the St. Lawrence, offers a fair site for a deep waterway from the head of the Galops to Lake St. Francis, opposite Cornwall.

The proposed deep water channel passes in Lake St. Francis from McKie's Point to Hungry Bay, where the St. Francis-Champlain Canal is to leave the lake. The line which it is proposed to follow between Lake St. Francis and Lake Champlain runs in an easterly direction across the depressions or valleys of the St. Louis and Chateauguay rivers, and after skirting the high ground near Ste. Philomene, bends almost due east and strikes for St. Johns on the Richelieu River—the total length of main canal being about 50 miles.

The final report of the commission, made after a meeting with the United States Deep Waterways Commissioners, at which the final report of that body was also presented to the joint commission, asserted the entire feasibility of constructing a deep waterway adequate to any scale of navigation which may be required between the several great lakes and the sea-board ; and, also, that it will be wise to provide for securing a channel of a navigable depth of not less than 28 feet.

"The most eligible route" is declared to be by the Niagara River, and by canal, on the east side, from Tonawanda to Olcott on Lake Ontario ; that the sea-board may be reached (from Lake Ontario) by the St. Lawrence River ; and that the American sea-board may be reached by the St. Lawrence River, and via Lake Champlain to the Hudson River, or by way of the Oswego, Oneida-Mohawk Valley and the Hudson River. The impossi-

bility of the Oswego route, which has been set forth by Major Symons, will be found on another page. The report is signed by O. A. Howland, Thos. Munro, Thos. C. Keefer.

## OUR RECORD.

DOMINION OF CANADA: PROVINCE OF ONTARIO. County of York. To wit: } In the matter of the circulation of THE CANADIAN ENGINEER.

I, Alfred Wesley Law, of the city of Toronto, in the county of York, do solemnly declare that—

1. I am the secretary-treasurer of the Monetary Times Printing Company of Canada, Limited, which company prints THE CANADIAN ENGINEER for Biggar, Samuel & Company, and as such have personal knowledge of the matters herein deposed to.

2. That the following statement correctly shows the number of copies of THE CANADIAN ENGINEER printed and mailed on the dates hereinafter mentioned, that is to say:

| Date of Issue. | | | | Copies Printed and Mailed. |
|---|---|---|---|---|
| Volume III., | No. 1, | May, | 1895 | 2,000 |
| " | " 2, | June, | " | 2,000 |
| " | " 3, | July, | " | 2,100 |
| " | " 4, | Aug., | " | 2,200 |
| " | " 5, | Sept., | " | 2,400 |
| " | " 6, | Oct, | " | 2,400 |
| " | " 7, | Nov., | " | 2,500 |
| " | " 8, | Dec., | " | 2,600 |
| " | " 9, | Jan., | 1896 | 3,500 |
| " | " 10, | Feb., | " | 3,000 |
| " | " 11, | March, | " | 3,100 |
| " | " 12, | April, | " | 3,150 |
| Volume IV., | " 1, | May, | " | 3,250 |
| " | " 2, | June, | " | 3,450 |
| " | " 3, | July, | " | 3,600 |
| " | " 4, | Aug., | " | 3,450 |
| " | " 5. | Sept., | " | 3,975 |
| " | " 6, | Oct, | " | 3,725 |
| " | " 7, | Nov., | " | 3,800 |
| " | " 8, | Dec., | " | 4,050 |
| " | " 9, | Jan., | 1897 | 4,100 |
| " | " 10, | Feb., | " | 4,350 |
| " | " 11, | March, | " | 4,350 |
| " | " 12, | April, | " | 4,350 |
| Volume V., | " 1, | May, | " | 4,350 |
| " | " 2, | June, | " | 4,000 |
| " | " 3, | July, | " | 4,350 |
| " | " 4, | Aug., | " | 4,400 |
| " | " 5, | Sept., | " | 4,500 |
| " | " 6, | Oct., | " | 4,400 |
| " | " 7, | Nov., | " | 4,600 |

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of "The Canada Evidence Act, 1893."

A. W. LAW.

Declared before me at the city of Toronto, in the county of York, this fourth day of November, A.D. 1897.

W. H. MOORE,
Commissioner, etc.

**To each of the first two persons sending us The CANADIAN ENGINEER of September, 1893, we will pay 50 cents, or one year's subscription.**

## A GREATER THAN STANLEY.

Canada has all reason to be proud of William Ogilvie, assistant astronomer to the Dominion Government. As we will be prepared to show in another issue, Mr. Ogilvie, as an explorer, is a greater man than Henry M. Stanley, the African explorer, because he has encountered and surmounted greater difficulties, has traversed a greater extent of unknown country, has opened a greater field for colonization, and pointed the road to greater wealth. More than this, he is absolutely free from that insufferable egotism which made Stanley personally offensive to many who knew him and had to serve under him.

Mr. Ogilvie has returned to Ottawa, where he is now busy preparing his special report, to be published early next year. On his way through Toronto he favored THE CANADIAN ENGINEER with a short conversation, some points in which were repeated at his most interesting talk before the Canadian Institute. One of the valuable points which he was generous enough to give to the mining readers of THE CANADIAN ENGINEER refers to the mechanics of mining in the Yukon. As the climate of the Klondyke may be said, to use the words of a pioneer, to be "nine months winter and three months late in the fall," hydraulic mining is out of the question. Where the thermometer ranges below zero so long, and the rivers are beds of ice, quartz mining will have to be conducted on a new plan. He suggests, therefore, a system of dry crushing, and a separation of the gold by a modification of Edison's plan of magnetic iron ore extraction. Of course, the magnet has no attraction for gold; but the gravity element of Edison's plan could be used by having chutes from which the crushings would be ejected, the greater gravity of the gold causing the precious metal to be thrown farther than the particles of rock, so that the greater part of the gold would be found in a heap at one end. There would be an intermediate space in which more or less gold would be found mixed with the rock, but this could be treated by the present amalgam process. An alternative plan might be a process of winnowing. Mr. Ogilvie gives the idea of the gravity system for the benefit of miners, leaving it to the mechanical engineers to work out the details of the machinery. Another very valuable suggestion he makes, which can be applied to the present placer mines, is the use of steam instead of fire in thawing the ground. The following conditions prevail in the placer diggings all through the Klondyke: for the first six to twelve feet the miner goes down through what is called "muck," that is, decayed leaves, and other vegetable matter, embedded in a network of tree trunks and branches. Then coarse gravel is encountered several feet in depth, and at the bottom of this gravel, lying on the more or less crumbled flags of the so-called bed-rock, the gold is found, nearly all of it lying within two to four feet of the rock surface. Now all this material of muck and gravel is frozen solid at all times of the year, and has to be thawed out foot by foot by building fires each day, the daily fire only penetrating the distance of about a foot. When the rock is reached the miner thaws a tunnel horizontally along the surface of the rock in the direction where the best pay gold is found, but it is not safe to penetrate more than twenty or thirty feet in either direction from the vertical shaft because the tunnel cannot be ventilated. Now, the use of steam in thawing the gravel would not develop any poisonous carbonic acid gas, but in fact would help purify the air, while the steam thawing would enormously increase the amount of work that could be done in a day. All that would be required in this process is a simple type of boiler, and a steam hose-pipe and nozzle. Mr. Ogilvie

proposes to demonstrate the advantages of this plan by having a sample steam thawing outfit manufactured and tested.

An important point brought out by Mr. Ogilvie, but which is not generally known, is that, by the treaty between Great Britain and Russia in 1825, all the bays, inlets and rivers extending through the Alaskan strip are open freely to navigation by Great Britain forever, so that there can never be any question of the right of Canadians to the use of the Skagway and other water inlets to the Klondyke.

In an area of thirty-five miles long by fifteen miles wide in the Klondyke, Mr. Ogilvie assures us that there are at least $100,000,000 worth of alluvial gold, and as he has proved that the pioneer miners of this region were Canadians or Old Country men, he believes that this vast wealth should be got by Canadians and kept in this country. This is the true spirit, and if the majority of Canadians were of the Ogilvie stamp, not much of the wealth of the Klondyke would be lost to Canada. The available timber of the Klondyke is being rapidly used up, but it is comforting to know from Mr. Ogilvie that over a large extent of country there are frequent outcroppings of semi-bituminous coal of a good serviceable character, and providentially these large seams of coal run parallel with the gold deposits, many of them being right along the river, where mining can be carried on cheaply. Still another remarkable fact is, that along with the coal and gold in convenient proximity, there are ample deposits of limestone, affording all the flux wanted in smelting. Both coal mining and quartz mining will commence in 1898, when at least 100,000 men will be working in the Yukon region. Cone Hill, in the Yukon, appears to be one vast mountain of gold-bearing quartz, far surpassing the Treadwell mine in richness. Some samples of quartz gold, which Mr. Ogilvie tested in a hand mortar, yielded as high as $1,000 per ton. In addition to the gold and coal, galena has been found in various places, and in the serpentine rock there is much low grade asbestos. Besides these minerals, an Indian recently brought in a block of pure copper, and when the source of this can be found another element of great value in these days of electricity will be disclosed. Of course, everyone will not get rich who goes to the Yukon. It will take energy and perseverance to develop these resources, but Canadians, with the help of British capital, are the people to do it.

## TORONTO'S FOLLY.

"*I will not give such a permit to the Mayor himself, nor to any member of the council.*" Reply of E. J. Lennox, to a representative of THE CANADIAN ENGINEER, who asked for a permit to view the new city buildings in order to write an article, which was to be one of a series on the municipal works and plant. The reason given was: "*The plans are being changed from time to time as obstacles arise,*" and further, "*I have the right to make such changes as I see fit.*"

At this time when the annual inquiry into the new Toronto city buildings and the city architect is being carried on, and public attention is being centred on the building operations, being conducted under lock and key on Queen Street, it has been thought wise to go somewhat into the history of the whole matter. It is unpleasant to tell the people of Toronto that the many delays in construction have not been made entirely that we might have a better city hall. It is harder still to discover that the city must pay much more before the building is completed, but it is hardest of all to find out that even then it will not be the pearl among city buildings we had fancied. Much credit has been given to the architect for the beauty of the design. We will give him less in future, however, when we study the elevation of the Pittsburg, Pa., Court House and County Buildings, which appears side by side with that of the Toronto City Hall on this page. Had the people of Toronto all visited Pittsburg in the last twelve years as Mr. Lennox has, they would, probably, have wanted the tower in the centre of the building, as it is at Pittsburg, instead of looking down Bay street, which

CITY AND COUNTY BUILDINGS, PITTSBURGH, P.A.

is the reason given for moving the one in Toronto. The whole mass of the building is very like, but is still unlike the work of the great Richardson, at Pittsburg. Where is the grand simplicity, the enormous scale, the perfect symmetry? It will always be a matter of regret to the people of Toronto, that Mr. Lennox did not go to Pittsburg oftener, stay longer, and "study" harder.

In 1884 it was decided to erect a new court house in Toronto. On December 20th of that year circulars were sent out to the architects calling for plans to be placed in competition, the author of the successful plan to be given the erection of the building. The cost of the proposed court house was limited to $200,000. None of the plans that were found desirable were within the sum stated, and all were returned to the authors and a new competition announced in May, 1886. The plan prepared by E. J. Lennox, the famous "No. 7," was accepted; the cost to be $200,000. It may here be stated that about the date at which all plans entered for the competition should have been filed, a delay of two weeks was granted, and for this step on the part of the committee no satisfactory reason has ever been given. At this time Ald. T. Hunter, who

TORONTO MUNICIPAL & COUNTY BUILDINGS
E J LENNOX ARCHITECT

was subsequently clerk of the works for many years under Mr. Lennox, was chairman of the Court House Committee.

The court house to cost $200,000 was proceeded with and the contract for the excavations and foundations was let to Lionel Yorke, and when it was seen that this portion of the building alone was costing $111,000 a halt was called and the new scheme of incorporating the city hall with the new court house was brought forward. W. H. Howland, then mayor, in a message dated Feb. 15th, 1886, points out that the unsanitary condition of the city hall and the lack of accommodation there will shortly render a new building necessary. He says that the required building can be incorporated with the court house, "the expense will probably not exceed $100,000 in addition to the cost of the court house, while a new city hall on a new site, built independently would probably cost $300,000 or more." He adds: "It will not delay construction of the court house as the architect, etc."

The architect was instructed to prepare plans for the combined buildings. In April, 1887, the issue of debentures to the amount of $750,000 was authorized by the ratepayers, which was in addition to $300,000 already issued—the whole to be employed in building the combined court house, city hall, and police court. It was deemed advisable to examine the plans to see if all the requirements of the architect's instructions had been fully complied with. The committee of council wished to appoint an expert, to have the architect appoint another, and the third by mutual agreement. The city nominated Matthew Sheard, but on his stating that his fee would be $1,000 for such examination, the project is lost sight of in the minutes of council for some time, but presently emerges in the form of a laudatory report on the plans by J. J. Withrow, Thos. Snarr, and Ex-Ald. E. Galley. They had been instructed "to examine and report upon the specifications for the new court house and city hall buildings, as to their fully describing and specifying the different qualities of workmanship, materials, etc., also to report upon the different grades of stone available for the said building." These experts stated that they had "made a careful examination of plans and sections to find if they showed as fully as they should the manner in which the work was to be executed." Their examination included "excavation, masonry, rubble, cut stone, brick work, drainage (partial), carpenter and joiners' work, copper and galvanized iron work, and roof tiling." There was doubt in their minds only as to the clearness of the specification in the matter of the sources from which the building stone was to be obtained. This report as to the satisfactory nature of the plans was dated February 7th, 1887. When a representative of THE CANADIAN ENGINEER called on the architect, November 30th, 1897, he was informed that he would not be admitted to the building to make any observations, "AS THE PLANS WERE BEING CHANGED."

Joseph Wright, of the Bennett & Wright Co., and W. J. Burroughes, were employed to make a further report on certain portions of the plans. They conclude a lengthy and most laudatory report thus: "We find that the plans and specifications, as now prepared, are of a similar description of work as is now being adopted in other large public buildings through the United States, and we are of the opinion that if the work is carried out as set forth in the plans and specifications, that the city will receive a first-class job of plumbing, gas, heating and ventilating works, and one that will give general satisfaction." It is sad to reflect that it is these very plans of the heating and ventilating plant upon which Mr Lennox is now making such changes as are from time to time desirable. It must worry Mr. Wright to be engaged upon a work which was in the first place so carefully planned and specified, and which is now being changed. It is to be hoped that the sum of $107,925 which the city has contracted to pay the Bennett & Wright Co. for this plumbing, etc., over and above the $80,000 which was the amount of the tender opened Sept. 6th, 1888, will mitigate the annoyance caused by any change.

Report No. 4 of the Court House Committee, Sept. 6th, 1888, states that the following tenders were received and opened:—

| | |
|---|---|
| Masonry, etc., Elliott & Neelon | $838,061 47 |
| Copper, galvanized iron, etc., Douglas & Co. | 7,900 00 |
| Painting, etc., A. M. Browne & Co. | 21,212 00 |
| Plastering, C. R. Rundle | 82,374 00 |
| Wrought iron, etc., Dominion Bridge Company | 91,150 00 |
| Roofing, G. Duthy & Son | 34,450 00 |
| Carpenter R. Dennis | 149,887 00 |
| Plumbing, etc., | 80,000 00 |
| Contingencies (estimated) | 25,000 00 |
| Furniture, architect (estimated) | 75,000 00 |
| | $1,405,034 47 |

Of these the masonry, copper work, painting, plastering, iron work and roofing, were let, and upon almost all of these the city has rendered itself liable to damages, owing to delays occasioned in filling these contracts which have arisen from time to time by reason of the action of the city or its architect.

The contracts, dated July 27th, 1889, require the work to be completed in three and a half years.

The delays were occasioned in the most various ways. The contractors charge that they did not receive the detail drawings from the architect in as short time as they should have done, and it has been established that when supplied the plans were in many cases defective. For instance, the foundation plan was found not to correspond with the excavation plan. The ground floor plan would not fit the basement plan, etc. The truth of this statement can be ascertained by examining the original drawings. Even at this time the plans were changed as "obstacles presented themselves." The contractor for the masonry was confined to one quarry, and its output was found unsuitable in some respects. The Credit Valley Quarry Co. which supplied the greystone found the demand exceeded its supply, and a fresh quarry had to be opened near Orangeville, Ont. The works were kept shut down for a large part of each year. The appropriations were exhausted and new ones had to be awaited. Recourse was had to litigation. Some of the contracts were let at much later periods than the rest, it being argued that during the delay prices might fall and the city would benefit. (The manner in which this worked out has already been shown in connection with the plumbing contract.)

Ald. E. A. Macdonald moved, seconded by Ald. J. Tait, May 17th, 1889, "that in view of the fact that the ratepayers are being called upon to vote upon a by-law to provide an additional sum of $600,000 for the erection of a combined court house and municipal building, and whereas the people have already voted $1,050,000 for that purpose, and whereas the public have no better assurance now that the $1,650,000 will complete the proposed buildings than they had that the initial appropriation of $300,000 would do so, etc., etc." Lost.

As the matter stands to-day, the people of Toronto are asked to vote a further large sum in the face of the heavy expenditures already made, of the fact that Mr. Lennox is still changing the plans, and that the original contractors, all and sundry, have undoubtedly rights of action against the city for damages, amounting in the aggregate to many times the proposed first cost of the building.

(*To be continued in next issue.*)

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL DINNER, TORONTO NO. 1.

The 11th annual dinner of Toronto No. 1, C.A.S.E., was held at the Richardson house on Thanksgiving eve, and was in some respects the most successful yet held. Over 100 sat down to a well-filled and well-served table, and Mr. Richardson was complimented on the excellence of the provision he had made for the happiness of his guests. The chair was occupied by President G. C. Mooring, with his Worship Mayor Shaw in the place of honor. In introducing the toast list, President Mooring welcomed the members, and recalled the progress made by the association since the time, eleven years ago, when about a dozen of them met in Bro. Wickens' house to organize for work on the lines which time had shown were so successful. He then gave the "Queen," which was enthusiastically received with "God Save the Queen." "Canada, our Home," was coupled with the name of Geo. Anderson, of the Royal Oil Company, who gave an interesting account of his recent visit to Japan as Trade Commissioner for the Canadian Government. The last address he had given on the subject of Canada was in Yokohama, where the name of our country had been received with special honor. There, and in other Japanese cities, on the occasion of his addresses before commercial audiences, the flags of Britain and Japan were draped together, and on one occasion it was shown in fireworks with the skill and effect for which the Japanese pyrotechnists are noted. Everywhere he went information on Canada was eagerly sought, and if Canadian merchants and manufacturers had enterprise enough to take advantage of their opportunities, an immense trade would be developed between this country and Japan in the next few years. On his way to Japan he passed through British Columbia, and was greatly struck with the vast natural resources of that province. On a visit to one of the canneries he saw two scows brought up, loaded with 24,000 salmon each, and the contents of both scows were to be boiled and canned that afternoon. In going through the Douglas fir woods he saw a tree 300 feet high, 11 feet in diameter, and 90 feet high before the first limb was reached. As to the mineral wealth of British Columbia, he heard it stated in England that capital to the extent of £250,000,000 was now waiting investment in Canada, chiefly in British Columbia. In Manitoba the wheat exports alone were valued at $17,000,000, and of other grains, $3,000,000. The combined exports and imports of Canada now amounted to $260,000,000, which were greater per head of population than any other country, and it was a fact also that we spent more per head of population on education than any country in the world. In reviewing the extension of the ocean transportation facilities of Canada, it was a grand thing to be able to say that one could start at Yokohama, Japan, sail across the Pacific to Vancouver, and thence by rail to St. John or Halifax, and on by steamer across the Atlantic to Liverpool, entirely by Canadian steamships and railways. George Grant then roused the enthusiasm of the audience by his rendering of Godfrey's song, "Land of the Maple." At this point Mayor Shaw came in, and was received with tumultuous cheers. Harry Brown sang "Beer," which was encored. The toast, "Toronto, Our City," was replied to by Mayor Shaw, who apologized for the lateness of his arrival, by explaining that he had already been to two or three meetings, and expected to attend three more before he reached home that night. He came to thank the association for the honor they had done him in inviting him to reply to the toast of "Our City." He was himself born in Toronto, and if anyone had reason to be proud of the city it was he. For 13 years the people of Toronto had retained him as their chosen representative in the Council, and the aldermen, chosen by the people, had in turn elected him to the Mayor's chair, and he had this much faith in their appreciation of him that he believed they would elect him to the same honor in January next, and that he would have the pleasure of opening the grand new city buildings, which would be finished within the year. He referred to the compliments passed upon the Queen's Own Regiment that morning by General and Lady Gascoigne. He looked on Toronto as the fairest city in Canada, and considered it one of the best governed cities in the world. He did not consider the factories of a city so essential as some other things, but held that if more attention was paid to our streets, and some attractive drives made, that these attractions, with our unrivalled educational facilities and climate, etc., would make Toronto famous as a summer resort for Americans and others. He referred to the proposed big new hotel, and said that Toronto was growing surely, if slowly, and that the gloom of the former real estate collapse was now disappearing. James Fax, the comic singer, who has always been a favorite among the engineers, then gave a song, which was heartily encored. "The Manufacturers" was proposed, coupled with the names of John J. Main, of the Can. Heine Safety Boiler Co., F. H. Leonard, of the Toronto Electric Motor Co., and James McLaughlin, of the Queen City Oil Co. After a good song by John Lester, Mr. Main replied, and said that judging from the enquiries for steam power, manufacturers had a good year before them. He took issue with Mr. Anderson as to the possibilities of Canadian trade with Japan, and did not see how Canadian manufacturers could compete with a people who lived on rice and worked for a few cents a day. Neither did he agree with the theory of the Mayor that Toronto's prosperity depended on summer visitors. He considered the establishment of factories of far more consequence, as new industries would bring a permanent population of more value to a city's various interests. As for the interests of the country at large, if the Government saw to it that such products as nickel were not only mined, but smelted and manufactured in Canada, instead of being shipped out in a crude state to enrich foreign corporations, it would be much better than contemplating visions of imaginary foreign trade. Mr. Leonard followed, and said that while he agreed to the policy of beautifying a city, it took the wealth of manufacturers and the labor of mechanics to accomplish these results. He did not feel at home in discussing questions of manufacturing outside his line of business, but on the subject of electricity he could say that there never was a time when so many important electrical developments were being made as within the past few years, and the progress made by Canada would surprise even many who are quite familiar with the subject. In Montreal, for instance, the electrical developments were second only to those of Niagara. The Lachine Rapids plant, just finished, and the Chambly plant, now in process of construction, were great electrical works which would advance the industries of Montreal in a wonderful way. For instance, a development in which he was personally concerned, was the transformation of the large steam plant of the Hochelaga mill, of the Dominion Cotton Mills Co.—the largest cotton mill in Canada—into an electrical plant. The mills were at present operated by three steam engines, aggregating 1,800 h.p., and these were to be replaced by a plant of 1,500 electrical h.p., the power being conveyed to the mills from the Lachine Company's powerhouse and transformed at the mills, where it would be distributed over the various departments of carding, preparing, spinning, and weaving, by motors connected direct to the line shafts, from which the carding machines, spinning frames, and looms were to be operated. By doing away with much of the present shafting, counter shafting, etc., now used in transmitting power to the different departments, losses ranging from 20 to 60 per cent. could be saved, and the successful issue of this work would result in many other improvements of a like nature in the power plants of the city. But as in ordinary cases water under a low head would not pay, and as power can be developed in a city like Toronto as low as $17 to $19 per h.p. per year from coal, there was no reason why industrial development should not go on steadily here. Steam was a good prime mover, and could always be depended on. He had seldom the privilege of speaking to an audience of people who controlled so much power as this, and he thanked them for the honor done him in being called on in connection with this toast. Mr. McLaughlin, in a short speech, said he had had the pleasure of being at these dinners for several years past, and was happy to be with the engineers once more. He regretted that owing to a slight indisposition the president of his company could not also be with them to-night. In considering their present position, his thoughts went back to the early part of this century, when the lot of the working man and mechanic was so gloomy. From a position which was a sort of slavery the working man had advanced till now, when many a man had more comforts than their masters of half a century ago. He pointed out that the exports of Canada had increased from $57,000,000 in 1886, to $121,000,000 in 1896, the trade returns at the present time showing exports of $3,000,000 more than the imports. He thought Canada was prepared to go the world over in trade and manufactures. After a well-rendered comic song by Bro. Thomas Eversfield, the "Educational Interests"

was proposed, coupled with the names of Prof. Galbraith, of the School of Practical Science, and A. G. Horwood, secretary of the Toronto Technical School. Bro. W. G. Blackgrove sang "Out on the Deep," which elicited a hearty encore. Prof. Galbraith said that as he had for the past ten years responded to this toast at this association's dinners, the honor might now be given into abler hands. In the work of technical education we were apt to overlook its social influence in giving so much attention to the practical side of the question. Once there was a great gulf between the uneducated and the educated man, but now, through technical education, all are being brought to the same level, the theoretical man being at one end, and the practical man at the other. Thus by technical education we are not only gaining knowledge, but drawing men closer together. Messrs. Fax and Grant then sang, to the great delight of the audience, a topical duet, with the refrain "Goodness Gracious," in which the following allusions were made to the association, the verses having been composed during the evening by Mr. Fax:

I've just heard some news which will cause you to say,
O ! good gracious !
The engineers flourish and prosper to-day,
Goodness gracious !
Just ten years ago they were hobble-de-hoys,
And as a society, just a few boys;
Now nothing on earth shakes their equipoise,
Gracious, good-goodness! Goodness gracious!

Since then they've increased, both in numbers and strength,
And spread the land o'er in its width and its length,
To judge from this gathering, as now it appears,
We'll be overrun sure in the next dozen years.
And if they keep on we'll be all engineers.

To be at these gatherings, is always a treat,
A jollier lot very seldom you'll meet,
From President Mooring to Wickens to-day,
And men of their stamp, there is none will gainsay,
They meet to do good, and have come here to stay.

Mr. Horwood, on behalf of the Technical School, said he looked after the business end of the institution, and was not competent to speak of the technical part, but since the establishment of the school he had noticed the effect of technical education, not only on the mechanical classes, but upon the policy of the Government itself. When it was first started it was a matter of doubt whether a system of secondary education was a necessity, but the Minister of Education had modified his views on the subject so far as to introduce a bill to enable High School Boards and County Councils to establish technical branches as an extension of their present system. Technical education had a great future before it, and one way to give the manufacturers of the country supremacy, was to educate the mechanic. Referring to the remarks of Mr. McLaughlin, he thought there was still a good deal of slavery among the working classes, but he believed the development of machinery and inventions would bring about a reduction in the hours of labor to the advantage of both men and manufacturers. "The Executive," was coupled with the name of Bro. E. J. Philip, the executive president, who spoke of the progress of the association. The Canadian association was not as big as that of the United States, but it was making steady headway, and held what it got. He mentioned the conference to be held the following day between representatives of the Ontario Association of Stationary Engineers and the C.A.S.E., for the purpose of revising the draft bill for licensing steam engineers, which was to be submitted to the Dominion Parliament at its next session. The engineers in the chief cities, such as Montreal, Toronto, Hamilton, and Kingston, appeared to take most advantage of the benefits of the association, and in this connection he paid a high compliment to the Hamilton branch, which was now doing the best work in education of any of the local associations. That association had planned a series of open meetings for educational purposes, which was creditable alike to its members and their outside friends, and he hoped to see the example followed elsewhere. Harry Brown then sang "A Hot Time in the Old Town To-night." Bro. Wickens, who was greeted with "He's a Jolly Good Fellow," spoke to the toast of the "C.A.S.E." He felt proud to be called the father of the association. This was the only body in Canada whose members spent their own time and money in educating and improving themselves. The first plank in their platform was the educational one. They were not a labor union, as many outsiders supposed; indeed, they were neither afraid nor ashamed to take the best and smartest manufacturers or employers into the association, and many of these manufacturers had found that they could learn something from the association. He was proud to recall the fact, already alluded to this evening, that eleven years ago the Toronto association had its beginning in his parlor, when about a dozen gathered, while now the C.A.S.E. extends from Montreal to Winnipeg, and he was not exaggerating when he asserted that there was not one of the members within range of his personal knowledge but had benefited by the organization, both in mind and in pocket. The one thing the association required was a Dominion license law. If it was not safe for a marine engineer to carry 15 passengers in a boat to the Island without being qualified by license, it was surely not safe for a stationary engineer to have unlicensed control of a steam plant in a factory with 500 people working over the engine-room. After four attempts had been made in the Ontario Legislature a permissive law was passed authorizing an examining board of the Ontario Association of Stationary Engineers to grant certificates of competency, and under this law 750 certificates had been issued to date, some of the holders being now resident in other provinces, including Manitoba, Nova Scotia, New Brunswick, and Quebec. Another proof of the good work done by the C.A.S.E. was that the Toronto Technical School was the outcome of agitation by the members; it being at their solicitation that the first vote of $2,000 to found the institution was passed. Last year the attendance at the Technical School was 1,500, while the total attendance of the three Collegiate Institutes was only 30 more; while the cost of the latter per pupil was $36.50, against $6.60 per pupil at the Technical School. The Toronto branch of the C.A.S.E. had paid out $400 for lectures, etc., and now have a library and other property worth $600. After a song by Mr. Grant, the "Sister Associations" was proposed, coupled with the names of Robt. Mackie and Robt. C. Pettigrew, of the Hamilton branch. Bro. Mackie said that when any of the Hamilton boys came here they felt as if they belonged to Toronto, as there was always a true brotherhood existing between them. They often had visitors from the Toronto branch coming to Hamilton, and they were always welcome. The educational features were stronger in the Hamilton Association than ever before, and through the efforts of men like Bro. Pettigrew, who was himself a member of the city Board of School Trustees, they were having a series of most instructive meetings this winter. Bro. Pettigrew said he was glad to be present on this occasion to share the hospitalities of Toronto branch, and thanked the association for the honor done him in being called on. The Hamilton branch was not so large as that of Toronto, but it was increasing, both in the interest of the meetings and in membership, some new members having been initiated at the last meeting. The fortnightly open meetings which had been aranged for the winter season, were likely to be productive of much good. They had already had a most instructive lecture from Bro. Philip on "Condensers," and they hoped to have other subjects treated by visitors from Toronto in the future. "The Press" was replied to by E. B. Biggar, of THE CANADIAN ENGINEER, and T. S. Young, of the *Canadian Electrical News*. Bro. Mackie, of Hamilton, proposed the toast of "Toronto No. 1," complimenting President Mooring, who returned thanks, and then proposed the health of the host. Mr. Richardson responded in a well-turned and witty speech, in which he showed that he appreciated the value of factories as an element in the progress of a city like Toronto. As for a big new hotel, which one of the speakers urged, he thought that might safely be deferred until some of the existing hotels were able to pay running expenses. The company broke up with "God Save the Queen," at 1.30 a.m. The dinner committee consisted of Bros. Samuel Thompson, James Huggett, C. Moseley, Thos. Eversfield (chairman), and Geo. Thompson (secretary), who did their work to the general satisfaction.

Toronto, No. 1, C.A.S.E., had the meeting hall destroyed by fire on the night of November 30th. The loss will amount to about $200, being chiefly upon the furniture. We hope the members and their friends will all rally to the aid of the society and once more place the society in possession of models, etc., to take the place of those destroyed.

On Thanksgiving Day a combined meeting of Toronto, No. 1, C.A.S.E., the executive committee of the C.A.S.E., and the Ontario Association of Stationary Engineers was held in Toronto to consider the steps necessary to secure legislation along the lines of the bill brought up at the last session of the Dominion Parliament. It was decided to push the bill in the same form as last year. Circulars are to be sent out to all branches of the C.A.S.E., and to all the members of the Ontario Association, urging them to bring all possible influence to bear on the different members of Parliament to secure the passing of the bill.

The Hamilton branch of this association held an open meeting in the hall, on Tuesday, Nov. 8th, President Wm. Norris in the chair. The meeting was well attended, and very interesting. Instead of having a regular paper read, a number of questions taken from the question-box were answered by some of the members present. President Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting remarks on the construction and use of magnets. Geo. Macki gave the formula, and explained the method of ascertaining the amount of horse-power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. The open meetings in connection with this society here are very interesting and instructive, and are well attended.

## HOW TO MEASURE.*

BY W. H. BALLARD.

In measuring anything it must be compared with a standard, the measurement of which is known. Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.), and compare the extent of the whole surface, which we do not know, with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other, and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by, the result must be, if by feet, the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot, or yard.

This brings us to the second point. In the first place, it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured, it must be compared with a certain definitely understood weight, such as a pound, etc. Value is measured by the dollar; area, by the square foot or yard; volume, by cubic inches, feet, or yards; length, by something which contains a certain known length; if any moving object passes through a certain space in a certain time, it is a measure of velocity. The surface of a cone is measured by multiplying the length of the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base, and go through the process of finding the volume of a cylinder, then divide by three, as a cone equals exactly one-third of the cylinder.

A simple way to find the height of a smokestack is by comparing the length of its shadow and comparing it with the shadow of some object of which we know the length. The Imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these points is the Imperial standard yard. In all measurements of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc.; and land was measured by the length of the foot-step. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight, and length.

*A paper read before the Hamilton Branch Canadian Association of Stationary Engineers at an open meeting, Nov. 23rd, 1897.

## THE GOLDEN NORTH.

It is easy to be brave in the presence of topographical and climatic difficulties on the printed pages, and as easy to overcome them—in fancy. The difficulties of Klondyke travel have already given pause to the crowd of inexperienced persons who rushed to the gold fields without due reflection, and with but little knowledge. Numbers who failed to reach the end of their journey are now the impatient citizens of Juneau, Skagway, Dyea, and St. Michael's, and those who have succeeded in reaching the mines have found that for the present gold is by no means the commodity of greatest value. That the deposits cover a vast area, and are unusually rich, is now established beyond cavil. According to Wm. Ogilvie, the gold-bearing zone extends from Cassiar, or probably Cariboo, following the general trend of the coast line through the head of the Hootalinqua, the Pelly, Stewart, Klondyke, Forty Mile, and across the international boundary to Circle City. The width varies from 10 to 150 miles. If this fact were supported by geological theory only, the great wealth of the recently-discovered placers would reasonably suggest that nearly all the gold was massed in a comparatively small area; but the statement is made on the authority of many actual discoveries of the metal in different places within this zone. Enough is already known of the neighborhood of Dawson City, and Cassiar is regarded almost as a dream of the past; but so recently as the end of October, Charles Law reported new and rich placers in the north-west portions of the Cassiar district, east of Teslin Lake, and the discovery of extremely valuable gold-bearing quartz. The placers themselves have been found to justify all that has been said of them. On Bonanza Creek there are about 100 claims that will certainly yield from $250,000 to $500,000 each, and on the Eldorado there are about 30 claims that will possibly average $1,000,000 each. Mr. Ogilvie expresses his settled conviction that the claims on these two creeks alone will yield close on $70,000,000 before they are exhausted. An old American miner, speaking of the wealth of these creeks to Mr. Ogilvie, said that the diggings in the Circle City district, which were once thought very rich, were merely Chinese diggings compared with them, and were outshone by single claims on the Eldorado. In the neighborhood of these there are many splendid prospects, which have yet to prove their actual value. Goldbottom, Hunker, and Last Chance creeks are known to be of immense value, and three branches of the Indian River—Dominion, Quartz and Silver Creeks, are reported to be second only to the Bonanza and Eldorado.

Hitherto luck has played an important part in the location of claims. It does not by any means follow that a claim next to one of the wealthiest will yield anything remarkable. Mr. Ogilvie tells of two men who had toiled for 42 years in the Yukon, never making more than a living, who came to own No. 24 Eldorado, and on cleaning up $11,000 each. decided to return home and end their days in modest comfort. The very next claim to theirs was owned by a young man who went in last summer, and who has already extracted more than the two old men own between them. Many of the now famous placers had been prospected before their real value became known. The Klondyke itself was run over in 1887, and again in 1893, but the wealth of its creeks remained hidden until 1896, when three men, named Henderson, Swanson, and Munson, announced their most extraordinary find, and thousands of persons last year walked over the neighborhood of Skookum Gulch, ignorant of the fact that under the moss lay a deposit of coarse gold, from which a miner could take in a day as much as a skilled mechanic could earn by a year's labor in a large city.

In the majority of cases, however, mining entails very hard work, and it must be remembered that the methods of prospecting for placers and lodes usually adopted are often inapplicable in the Yukon. The deposits of gold are usually covered with silt, to a depth of from eight to twenty feet, which was deposited on the top of the gold-bearing layer after the stream had ceased, as a rushing torrent, to tear the exposed metal from its rocky bed; and the discovery of such placers will entail a vast amount of patient labor. It is sometimes necessary to dig twenty, and even thirty holes, at about the rate of a foot a day, before pay dirt is struck. Mr. Ogilvie mentions a case in which a man had dug eleven holes without finding anything. Notwithstanding this, some others retained their confindence in the claim, and paid $2,500 for a half interest in it.

The discovery of Cone Hill, which seemed to be one extensive block of rich quartz, is already known to our readers, but we may add that it produces from $5 to $7 a ton, and there are six other quartz claims in the neighborhood of Forty Mile and Dawson. A Montana expert miner has located two claims about 40 miles up the river, which produce from $3 to $11 per ton, and on Bear Creek is another, which Mr. Ogilvie rates as one of the best properties in the country, while on Gold Bottom Creek there is a claim from which specimens treated merely by a hand mortar, produce from $100 to $1,000 to the ton. Quartz has been reported in other places by Dr. Dawson and the mother lode remains to be discovered. Bitter disappointment or bewildering success may await the discoverer; but enough is already known to make it certain that quartz mining will become an industry directly the facilities for transportation are increased.

The Minister of the Interior was so impressed with the need of this during his recent visit to the confines of the Yukon district, that he took the earliest opportunity on his return to give public assurance of the purpose of the Government to make the most complete arrangements possible. All the routes have now been traversed by Government agents, and we may expect soon to hear of some permanent plan for the easiest and cheapest transport, not only of gold, but of all the wealth of the Yukon, through Canadian territory. There are proposals for railways, tramways, cable ways, or wagon roads, along every known route to the neighborhood of the mines—from the coast, or from the central portions of British Columbia and Alberta. Steamers are to ply the Mackenzie and Porcupine, the Yukon and the Stickeen, wagon roads and railways are to connect the C.P.R. and the head waters of the Pelly and the Hootalinqua, and cableways and tramways are already in course of construction over the passes.

The route which seems to recommend itself to the Canadian Government is that by the Stickeen River. In this case the steamboats, which leave Victoria every few days, will carry you through the Seymour Narrows to Port Simpson, the most northerly Canadian port on the Pacific, and thence to Fort Wrangell. From here you ascend the Stickeen River to Telegraph Creek. There a portage of 150 miles to the head of Teslin Lake is necessary. This portage runs through an undulating and fairly well wooded country, where natural hay might be found for a limited number of horses, and has recently been surveyed, with the object of constructing a railway from Telegraph Creek to Teslin Lake. On arrival at the head of the lake, lumber is cut from the trees in the neighborhood, for making the boats which must transport you down the lake, a distance of 80 miles, and thence down the Hootalinqua to its junction with the Lewes, a further distance of 125 miles; and then on down the Lewes to the Pelly or Yukon. The distance from Victoria to Dawson City by this route is approximately 1,600 miles.

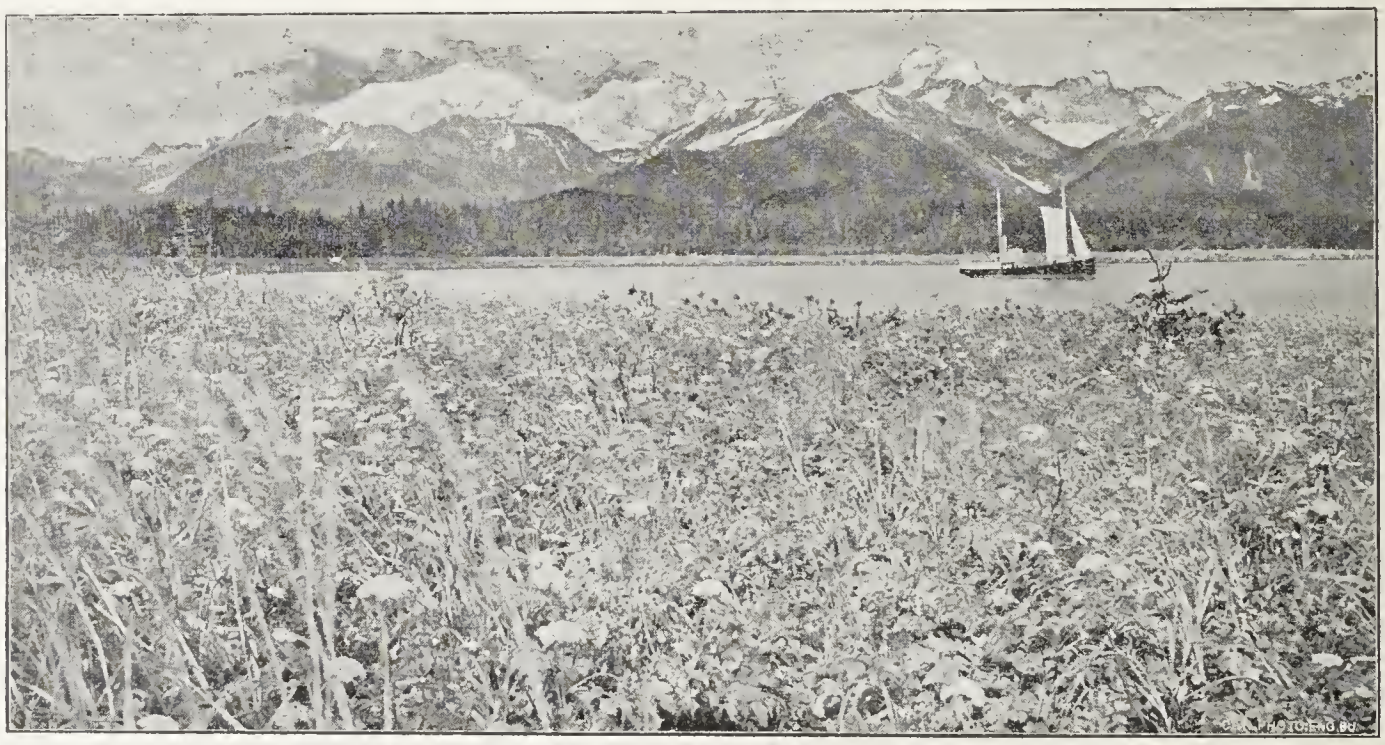
It should be remembered that Hudson Bay traders have been in the habit of entering the Yukon district from British Columbia, entirely over land, for years. Many travelers have recently chosen this route, and one of the police parties was sent that way, with instructions to report upon it. A company has been incorporated under a British Columbia charter, which proposes to build a toll road from Edmonton to St. John, on the Peace River, thence to Lake Teshudy, then across country to the Liard, and then along the Frances to the head waters of the Pelly. J. B. Powell, the promoter of this company, asserts that passengers will reach the Pelly River two weeks after leaving Edmonton.

## SHIP V. BARGE CANALS.

The reconstruction of the map of North America, so that the products of the northern part of the United States might find their way to the Atlantic seaboard without passing through the territory of a foreign power, is a problem which has been much dwelt upon by the numerous statesmen of the United States for many years past. Failing to annex the St. Lawrence route, engineers have been called upon to construct one. In a former issue of THE CANADIAN ENGINEER we discussed the different routes by which it was considered possible to build a waterway from Lake Erie to the Hudson River. Of the three leading ones discussed, the engineer instructed by the United States Government to make a report on the subject, Major T. Symons, goes into the merits of that by way of Oswego alone. In this scheme a new canal would be constructed from Lake Erie to Lake Ontario, and from Oswego on Lake Ontario, to the Hudson River. Major Symons, however, only discusses this plan in order to show how impracticable it is. The lowest estimate of cost which he considers at all is $200,000,000, and annual cost of maintenance he believes would be at least $2,000,000. In this rough estimate of the cost little account is taken of the fact that the Mohawk Valley would be flooded, and enormous damages result to the New York Central Railway and other powerful corporations. The expenditure on impounding works for the storage of water in the Adirondacks would also amount to a vast sum.

The whole project may therefore be dismissed from the public mind as being something which is too expensive for even the people of the United States.

In laying aside the proposed ship canal, however, Major Symons urges strongly the enlargement of the present Erie Canal, so as to give passage for barges 200 feet long, 30 feet broad, and drawing 10 feet of water; that the locks be reduced in number, and arranged to give passage to two boats at one lock, with mechanical lifts to replace flights of locks where advisable; the business to be conducted by fleets consisting of one steam barge and three motorless consorts, running between Buffalo and New York; the barges to be strong enough for running on the Great Lakes. Major Symons claims that if a ship canal were built the business would not be done in large lake or ocean vessels, but in barges and boats which could be equally well accommodated in a canal of less size. He furnishes a vast number of statistics and a great many tables in



LITUYA BAY, LOOKING N. N.-E. MT. FAIRWEATHER TO THE LEFT, AND MT. LITUYA TO THE RIGHT.

support of the above propositions. We have only room for reference to the following: Estimated cost, Chicago to New York, including lake freight, 1.37 cents per bushel, transfer charges 2-3 of a cent per bushel, and 10 per cent. profit on cost of transportation between Buffalo and New York:

| | Cents. |
|---|---|
| By ship canal, in 5,000-ton vessels, per bushel | 4.46 |
| By 1,500-ton barge canal, with semi-independent motive power and consorts, per bushel | 3.05 |

If what Major Symons claims is true, the present outlay on the St. Lawrence canals is not a necessity; but if barge canals are all that the traffic requires, why is the St. Lawrence route at present comparatively deserted, the Ottawa canals hardly ever in use, and the locks of the Rideau system rotting in idleness?

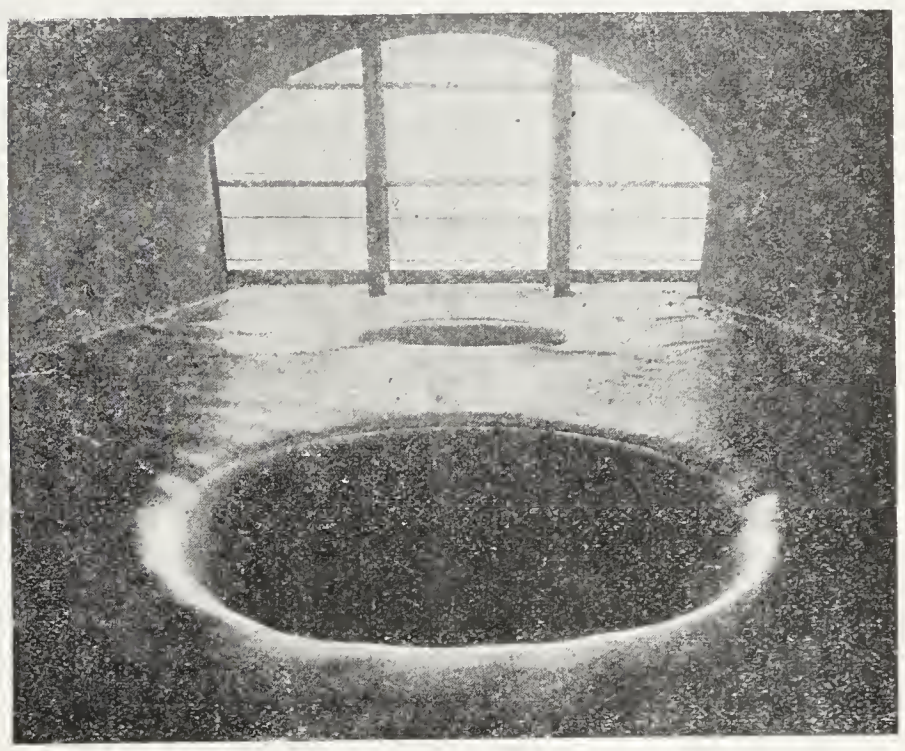
## THE CHAMBLY POWER PLANT.*

Four important long-distance transmission plants using water power as the prime mover have recently attracted much attention. While two of these plants, Chambly and Mechanicsville, are quite alike in their salient features, they are widely different from the other two at Bakersfield, Cal., and Three Rivers, Que., and among them is represented a wide variety of engineering. There can be no doubt that the application of water power for electrical generation and transmission is a rapidly developing art, and that in many places in the country hitherto unproductive streams may now be turned to good account by means of electrical transmission of power. Taking all these plants together, perhaps the most striking feature to electricians of the older class is the enormous potentials which they employ, and the extreme simplicity of the means by which these are controlled and handled. It apparently needed the example of the Niagara installation to induce the investment of large capital in enterprises of this character. Despite its glaring defects of engineering the Niagara plant still stands foremost as a representative installation, and its unquestioned success has been the means of widely encouraging the establishment of similar plants. It is pleasant to be able to entirely commend the work that has been done on some of the new installations. Perhaps it is fair to say that, in many respects, the plant at Chambly is one of the most carefully planned and best designed that has yet been constructed. While many engineers will feel at first some doubts about the propriety of running dynamos below the water level of the forebay, it seems that it should be easily possible to guard against anything short of an absolute overflow of water over the crest of the dam at a point above the dynamos. With any reasonable variety of hydraulic engineering this casualty could be placed in the category of visitations of Providence, since it is possible to guard against every conceivable variety of accident which would make such an overflow possible. Dampness is no longer such an enemy to insulation as it was in the older days, but it would have been perhaps equally easy to use a type of wheels with vertical shafts and put the dynamos high and dry above the water level.

TWO STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

*Reprinted from the *Electrical World*, New York.

Whatever may be said about the electrical features of these installations it cannot be denied that the hydraulic engineering at Chambly is of the very highest class. It seems that the means adopted must secure the highest possible efficiency, and it would be difficult to conceive of more beautifully simple and direct mechanism than that employed. The only feature of their work about which the hydraulic engineers may feel any doubts is the method of governing employed. The physical difficulties in the way of governing water wheels are very great, and this is especially true in turbines in which a large volume of water in motion, possessing enormous inertia, has to be handled through the agency of gates, themselves necessarily heavy and difficult to move. There seems to be no escape from this particular feature of water-power work, and the engineers who have designed the governors in use at present are to be congratulated upon having accomplished such excellent results under such difficult conditions. The simultaneous construction in this country of half a dozen or more plants of the largest size and highest class for long-distance power transmission can be regarded as very gratifying evidence of the success which has marked previous installations. It also points to the not distant day when any water power, of any considerable size, within transmission range of a centre of population, will be utilized in this way. What this means to the citizens of towns the greater part of whose power is brought in in this way is hard to realize at first. It is possible that successful long-distance transmission of power of this kind may result in smokeless cities, as it certainly will result in the cheapening of power and its small sub-division and application to many uses to which it is not now applied. In this way, as notably heretofore in the case of the electric light and the electric street railway, electrical engineering has had a direct influence upon the social environment for the greatest good.



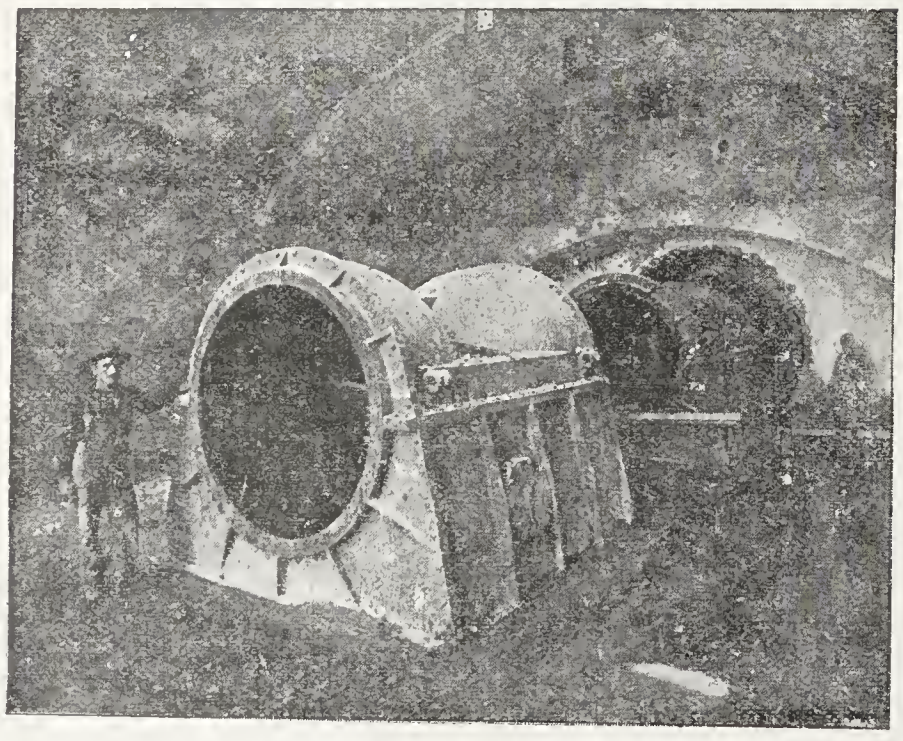
FLUMES AND DRAFT TUBES BEFORE TURBINES WERE SET.

In a recent number of the London *Electrician* a list of some large installations in America in erection and under contemplation is given, and the question asked: "What will we do with it all?" referring, of course, to the vast powers. It may be proper here to say that there is no country in the world which can absorb so much power or find so many uses for it as this. The development of a great power at any point produces an industrial condition which shortly results in the establishment there of works which find it to their benefit to seek cheaper power or different conditions. In this way there has grown up around Niagara Falls a great manufacturing city, which is rapidly extending. It is by no means visionary to hope for the establishment of similar great centres of industry within the working radius of electrical transmission from other such sources of power. The actual powers used in industries in the United States are probably much in excess of the total of all the available water power in the country, and the question asked by our contemporary seems to answer itself when this fact is considered.

Canada is a region of gigantic water powers, which have waited for the advent of electricity to be utilized for the many purposes to which they are applicable. Perhaps the finest installation for the development and transmission of the power

of falling water extant is that of the Chambly Manufacturing Company, at Richelieu village, Quebec. At this point, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river and Chambly on the other has been in existence, supplying power to a few small mills. The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive concrete dam, in which, as an integral part, is built the power-house, with a capacity of 20,000 horse-power.

This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed but also the largest concrete dam on the continent. The dam consists of three portions, two of which run perdendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power-house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery. The upper level, which is about 2 feet above the surface of the water in the lake, formed by the dam, will contain the switchboards and controlling devices and such offices as are necessary. In this part of the dam eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other, in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives, since these draft tubes are the largest ever constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently



CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.

expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speeed of 153 r.p.m., each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

The governing of the wheels will be by means of Giessler electro-mechanical governors. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electromagnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governor in other large hydraulic installations.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse-

BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLEWAYS

power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was furnished by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2,000-kw. generator, giving two-phase current at 60 cycles per second and 12,000 volts. These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, Montreal, from designs by the Stanley Electric Manufacturing Company, Pittsfield, Mass.

In the space above the flumes in the upper portion of the powerhouse dam a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber-insulated cable will be used for these. In the walls of the power-house a number of large terra-cotta pipes, about 3 feet long, bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building. Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the centre of each. A line of barbed wire is run along the tips of the poles, and four similar lines are attached to the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short distance below the main line a short cross arm carries the two No. 12 copper wires of a telephone circuit. The main power trans-

mission line will end in the electric-light station of the Royal Electric Company, at Montreal, where 6,000 horse-power will be used for incandescent and arc lighting and direct-current motor service. The large two-phase generators now employed in that plant for incandescent lighting and power will be rewound as synchronous motors, and connected directly in the 12-000-volt circuit. These machines will then be belted by a system of countershafts to the arc light generators and other continuous-current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be aranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1,000 and 2,000 volts, two-phase.

These transformers are now under construction at the works of the Royal Electric Company, Montreal. Their

UPPER SIDE OF DAM, SHOWING WASTE GALES.

greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet-iron water jacket. As the plant in Montreal is some feet below the level of the Lachine Canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

The troubles with ice, which have been for so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least 1½ miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current

DAM SHOWING POWER-HOUSE.

is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, J. G. Mecklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation on time.

It is expected to deliver nearly 20,000 electrical horsepower from this plant in Montreal, when the total equipment is installed at Chambly.

## APPLICATION OF ELECTRICITY TO STEAM RAILROADS.*

BY N. H. HEFT.

The New York, New Haven and Hartford Railroad Company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third rail system, and 14 miles on the overhead trolley system.

About three years ago, the New Haven Company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that by no ordinary methods of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors, and commenced a series of elaborate experiments in heavy electric railroading. It must be confessed that this decision was reached only after some misgivings. To the average railroad man, street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact that "the tail will wag the dog" unless some radical action is taken, particularly in suburban and short distance work, and, in the Eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading.

The first line to be equipped by the New Haven Company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the main land on the Massachusetts Coast from Nantasket Junction to Pemberton, a distance of about seven miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with centre pole construction, and everything made very strong and more substantial than was at that time found in any street railway work to our knowledge. At the time of construction of this overhead line, there were no suitable movable switches in the market, and we had to remodel and have built especially for our purpose those which we finally adopted. One feature, perhaps, worthy of note, is the connection of the overhead switch with the track switch in such a way that both are controlled by a single lever at the switch stand.

The line was operated for the first summer with excellent success, and, all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth division, from Nantasket Junction to East Weymouth, this section being operated by the third rail system. In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, three miles of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin at one end of this line, partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the centre of several radiating lines, which may eventually be put in operation by electricity.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares, and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting. The time has come when every progressive railroad manager must recognize that new conditions and the new character of competition require a complete change of operating methods.

On its Nantasket Beach line, the New Haven Company gave, during the last summer, a regular half hour service from 6.30 in the morning until 11 30 at night. The fares charged on the Nantasket Beach line before the advent of electricity were ten cents from Pemberton to Nantasket and eighteen cents from Nantasket to East Weymouth, a total of twenty-eight cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of five cents from Pemberton to Nantasket and five cents from Nantasket to East Weymouth. Under these new conditions the traffic has increased enormously on this line, the summer of 1895, the first of electrical operation, showing an increase of 92.6 per cent. over the previous summer in the number of passengers carried, the summer of 1896 showing 45.1 per cent. increase over 1895, while in the summer just passed, we have carried nearly three times as many passengers as

*Condensed from a paper read before the American Street Railway Association; Niagara Falls, N.Y., October, 1897.

in the last year of steam operation. The operation of the line from New Britain to Hartford was commenced in May last, with a regular half hour train schedule from 6.00 in the morning to 11.30 at night. and with a uniform fare of ten cents each way, instead of twenty-three cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. Sixteen trains each way per day are run, connecting with steam trains. Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent. more passengers than we carried through the corresponding months of last year.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are several grades and a great many curves on the line. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10.6 miles in length, or an average distance between stations of about six-tenths of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes: to be obliged to do this in order to connect with boats arriving at regular half hour intervals—are things which cannot possibly be accomplished by steam locomotives. The reason is found in the tremendous accelerating power of properly designed electric motors with rotary motion, as compared with reciprocal motion of steam locomotives. On this line, for example, a 60-ton train in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from power station to Nantasket Junction, a distance still of but 5,808 feet, a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops. Between Hartford and New Britain, the 9 3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made; the entire distance of 9 3 miles being covered in 10 minutes. On this line, between Hartford and New Britain, a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single car trains are run.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long-established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding. With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line, we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now, we have in mind plans o combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125-h.p. motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already on the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances, great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed towards completely encasing the motors, so as to make them waterproof, but in doing this, ventilation has been sacrificed. We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air brake reservoir, but this is, at best, but a makeshift. It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air brake cylinders and apparatus, switches and other car-controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment, as to who shall have the first right to a given space, perhaps hardly half a dozen square inches in section. There is also more or less trouble with abraded wires, short circuited shoe hangers, etc., and for our future work, we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor, several inches below, specially provided for the purpose,

For operating heavy trains of this character, where currents of from 500 to 1,000 amps. are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected. The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length. The problem of braking, which is so important a one in street railroading, is found more so with us, since the train weights and speed are enormously greater. The regular Westinghouse air brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors, we have an electric motor compressor controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolley on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced, so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes, and connected with the circuits on the motor car by means of flexible couplings, and it is possible, therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

Our third rail and return circuit experience will be of value, as we have made a wide departure from established methods. First is the question of insulation. The third rail has a potential of 600 volts above the ground, and rests upon creosoted wooden blocks doweled into the ties, its eaves being only 1⅝ inches above the tie. Now it frequently happens that water accumulates two inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being about two feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places, 10 miles apart, during a heavy rain storm, and we have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result. We aim to so connect our third rail lines and the service rail return, as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and, though ground plates are placed at the

station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests. The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Tapered pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. The form of this service rail bond is shown in Fig. 5. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves. Some of the tests of our third-rail and service rail bonding and of the experiments which have led up to our present practice may be of interest, and are given below.

A few words about the danger of the third rail system would be, perhaps in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days, our employees work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse play. On wet days, they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employees have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system. As a result of exceptional care which we have taken in bonding our third and service rails, we have found it unnecessary, in any third rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station. This work is made up as follows: From Berlin to New Britain, a distance of three miles, there is a complete double track electric road with two 100-lb. third rails, and four 74-lb. service rails, all most carefully bonded as described above. From New Britain to Hartford, a distance of 9 3 miles, there is one complete electric track, with 100-lb. third rail and 70-lb service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fish plates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line, with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amps., with a maximum flow of about 700 amps., at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would, undoubtedly, be necessary to reinforce the third rail with feeders. The method of bonding the third rail has already been described and illustrated in previous numbers of THE CANADIAN ENGINEER.

In our Nantasket Beach station we have installed two engine generator units of 800 h.p. and 550 k.w. capacity each. The steam is supplied by eight boilers of 200 h.p. rated capacity each. On heavy days both these engines are required, but on ordinary days but one only, and this is not fully loaded; the average loads being, perhaps, one-half the maximum. In the Berlin station we have installed two engine generators of 1,200 h.p. and 850 k.w. each. The steam is supplied by ten horizontal tubular boilers, of 200 h.p. each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity. In both stations our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character. The details of piping and arrangement of steam apparatus have been so thoroughly described in the technical papers that it is unnecessary to refer to them here. We are now running our Nantasket plant condensing and our Berlin plant non-condensing, the loads in the latter being too light to make condensing profitable. In spite of the fact that these general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of seventy cents per ton delivered. In order to burn these sparks, we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft, as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases, which increase greatly and facilitate the combustion of half-burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates, together with the steam blower, there is no difficulty. In our experimental days it was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course, we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us in Connecticut about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only, of 500 h.p. total capacity, direct connected to one 300 k.w. generator. In the boiler room are six 200 h.p. boilers. For the first six months of full operation with sparks only, the total cost of fuel for this station amounted to three mills per horse power hour, or four mills per kilowatt hour. For so small a station, and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat, in order to load the engine up to more nearly its full capacity. As a result of these tests, we find the cost of fuel for power, with the use of coal, to be 3.2 mills per horse power hour, or 4.2 mills per kilowatt hour. With the use of sparks, the cost is reduced to 1.9 mills per horse-power hour, or 2.5 mills per kilowatt hour. At our Nantasket power station this season the cost of fuel, with the use of coal, has averaged 4.2 mills per horse-power hour, or 5.6 mills per kilowatt hour, while, with the use of sparks, the cost has been 2.1 mills per horse-power hour, or 2 8 per kilowatt hour. As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station, the cost of fuel, with the use of coal, has been nine mills per horse-power hour, or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to three mills per horse-power, or four mills per kilowatt hour. It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton-mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

## BOILER INCRUSTATION.

When natural waters containing dissolved and suspended foreign impurities are fed to steam boilers for the purpose of generating steam, the fixed and non-volatile nature of these matters insures their remaining behind in the boiler, where subjected to high temperature of heat they finally become baked and firmly attached to the tubes and shell, forming boiler scale, which prevents the water from coming in contact with the iron and by resisting and obstructing the passage of the heat to the water, not only occasions a great loss of fuel, but imperils the boiler to burning, blistering and bagging, and threatens explosions. It is of obvious importance, that the purest feed-waters obtainable should always be selected; but water is seldom found entirely pure.

Steam users who are troubled with scale in their boilers should always consult with some reputable and responsible chemist who has made this subject his special study. His success depends, not only upon a knowledge of water chemistry, but in a great degree must also depend upon a thorough knowledge of practical boiler operation, and the peculiarities and special features of every design of steam boiler met with on the market; therefore, it will readily be admitted, that much discrimination should be shown in selecting any particular chemist to meet this requirement. Many engineers resort to the plan of removing boiler scale by the use of the pick, hammer and chisel, but this is a temporary relief, and does much to weaken the iron. The skin formed on iron during its process of manufacture, is its strongest part, and affords the metal its best protection against oxidation and corrosion.

Some engineers, owing to the parsimony of their employers, use their own chemical formulas to prevent scale in their boilers, rather than undergo the arduous task of cleaning their boilers by hand. This practice cannot be too strongly condemned, as the steam boiler is a very poor place to start up an experimental chemical laboratory; besides, these engineers will seldom meet with success, as their knowledge of chemistry is too limited, while often they are ignorant as to the character of their feed-water and the nature of its impurities which form scale in their boilers.

Distilled mineral oils have of late years been much used for this purpose. Aside from the danger incident to the presence of these inflammable oils in manufacturing establishments, from risk of fire, the makers of Lord's Boiler Compounds claim, these oils promote leakage of the boiler parts, the burning and crystallization of the material and overheating of the plates. Some engineers claim that when oil is intelligently used these evil effects can be obviated. These oils are very penetrating, as is seen in their removal of rust from tools; and in penetrating the boiler joints, they so lubricate these parts that the forces of expansion and contraction easily cause them to leak badly. Besides, oil tends to throw down the scale in large fragments, which accumulate over the furnace plates, producing overheating, bulging and blistering, while seriously obstructing the circulating currents. Oil, when it works its way back of boiler scale, detaches the scale, which falls off, and brings in contact the practically cold water in the boiler with the overheated plates on which the scale was attached. Engineers should always consult with some chemist in these matters, and Geo. W. Lord, the maker of the celebrated Lord's Boiler Compounds, is said to be a competent party with whom to correspond. Mr. Lord is represented in Canada by C. E. Grant, 13 St. John St., Montreal.

## ACETYLENE IN MANITOBA.

The following regulations for the use of acetylene gas have been published by the fire underwriters of Manitoba:

(1) No generator shall be located in any building where insurance policies cover that can generate gas under a greater pressure than that sufficient to distribute it through the pipes of a building, or under a greater pressure than that used with ordinary city gas.

(2) Each generator must be properly designed, and have sufficient capacity for the work it has to do, and must be made in such manner and of such materials as to insure durability and stability

(3) Each burner burning one cubic foot of gas per hour shall have at least one pound of carbide for its supply in the generator when first loaded, to prevent too rapid generation of gas.

(4) No generator shall be installed, the maximum capacity of which is less than one pound of carbide for each one foot burner.

(5) Each generator must be so constructed that when the lights are extinguished the supply of water to the carbide, or the supply of carbide to the water, will cease automatically.

(6) Each generator must be provided with a connection leading out doors, which, in the event of an accidental over-production of gas, will convey such surplus to the outside air.

(7) The room in which the generator is placed shall be well ventilated, so that any escaping gas may not be confined in said room.

## A SMALL DRY BATTERY.

Something of a novelty in the form of a dry battery has lately been submitted to us for examination by Tage Muller, of New York. This cell, which is very compact, stands about two and a half inches high, 1½ by ¾ inches broad. Upon connecting this small cell with an electric bell we obtained just as powerful a ring as a larger dry cell would have afforded. It was also tried on an induction coil with very good results, producing a perfectly steady and strong secondary current. Indeed we should say that it was a very good cell for this last named purpose as it is so light in weight and easily stowed away in the pocket until ready for use. The makers claim that a person starting on a trip for pleasure or otherwise, and wishing to take with him a small medical battery, could find no battery better or more convenient than one of these cells. It would be ready for use at a moment's notice, no difficulty as to chemicals or salts, no cleaning out after use, or any other inconvenience which may be found in many other forms of portable medical batteries. Then take the wire-man going to test out a circuit for warehouse telephones or something similar. To him this small battery would prove extremely handy. In conjunction with a testing gauge it could be placed in his pocket and carried about from place to place with the greatest ease. Of course we have only been able to give its good points as they have appeared to us in our tests. The life of the cell, etc, can only be found by constant use, but considering its small size and great strength, we can see no reason why it should not prove useful to both amateurs and professional men. The name of this cell, manufactured by Mr. Muller, is the "Unique Dry Battery No. 1."

## CORUNDUM IN ONTARIO.

The following information on the deposits of corundum in Ontario is compiled from the Report of the Ontario Bureau of Mines for 1896:—

In October, 1896, Dr. G. M. Dawson, Director of the Geological Survey at Ottawa, communicated to the Ontario Government the discovery of corundum in the township of Carlow, in Hastings county. This discovery was made by W. F. Ferrier, of the Geological Survey. In 1893 Mr. Ferrier bought a number of specimens collected by John Stewart, formerly of Ottawa, amongst them being a package labelled "Pyroxene crystals, south part of Carlow," which were recognized as corundum. He was authorized in October to visit the township of Carlow to locate the mineral and determine the extent of the deposit. It was found to occur in a coarse-grained red, felspathic rock, having the appearance of a pegmatite. This rock, together with a red and brown micaceous gneiss, forms a perpendicular cliff from 80 to 100 feet high, at the base of a sloping mountain. The corundum-bearing rock runs into the gneiss side of the mountain along the strike, as well as occurring, as already stated, on the face of a cliff across the strike. Well developed crystals, often of large size, and generally of a grayish or brownish color, as well as irregular masses of the corundum, are thickly distributed through the rock, and the mineral was observed throughout this rock for a distance of about 300 feet across the strike, and traced along the strike more or less continuously for about 700 feet. The grain of the mineral varies with that of the rock. The quantity is not uniform throughout the mass, portions of the rock being more thickly studded with the crystals than others, and in places they seem to form "stringers" in the rock. The interest of the find lies not so much in the possibility of the discovery of the gem varieties of the mineral, ruby and sapphire, about which so much has been said, and which is improbable in view of the mode of occurrence, but in the fact that this is the first time that the mineral has been found to exist in Canada in any quantity, and that it is valuable as an abrasive material on account of its great hardness, which is in a pure mineral next to that of the diamond.

Corundum is an oxide of aluminium, the crystallized varieties being essentially pure, whilst the granular variety, to which the name "emery" is given, contains more or less impurities, chiefly magnetite and hematite. The transparent purer kinds of red and blue colors constitute the gems ruby and sapphire. These usually occur as rolled pebbles in river beds, or as crystals embedded in various rocks, such as limestone, as in the famous ruby mines of Burmah. Statistics show that as an abrasive material there is an extensive market for the corundum. The supply of the mineral in the United States comes chiefly from North Carolina and Georgia, small quantities of emery being also obtained in Westchester county, New York. The finer grades of emery continue to be imported from Turkey and Greece.

Since the present discovery was announced by the Geological Survey, numerous enquiries have been received regarding it, and samples have been furnished to interested parties. Some of these have been tested in the United States, and the corundum pronounced to be of the finest quality. Under instructions of the Commissioner of Crown Lands, a quantity of the mineral was taken out of the Carlow deposit and shipped to the works of the Hart Emery Wheel Company, at Hamilton, Ont., where a test was made of it; but the quantity treated was not sufficient for a satisfactory determination of its value. The report, however, was quite favorable regarding the abrasive qualities of the mineral. Numerous samples were distributed by the Bureau to mineral collectors in the Province, as well as to prospectors, and there is reason to believe that corundum occurs over a wide area in the eastern counties. An interesting discovery was made by George Bennett at a mica mine in the township of Methuen, samples of which have been examined by several experts. George F. Kunz, of New York City, describes it as in part of an excellent blue color, although not of sapphire value, but of abrasive value equal to

any that he has seen from South Carolina, Georgia or elsewhere. Dr. Coleman also made an examination of corundum and another curious mineral from the same location, and in a report upon them says: "The two specimens of corundum are of better appearance than those previously found in Ontario, lacking the soft, decomposed surface seen on former ones. They are also more translucent, and one of them approaches sapphire, having at some points an ultramarine blue color. The corundum is associated with a little muscovite. Both specimens show one well-marked cleavage, no doubt basal, and three less perfect cleavages corresponding to the planes of the chief rhombohedron. The main cleavage faces are striated in three directions, forming equilateral triangles in accordance with the less perfect rhombohedral cleavages. The blue specimen comes nearer to gem quality than any other specimen from Ontario which I have examined."

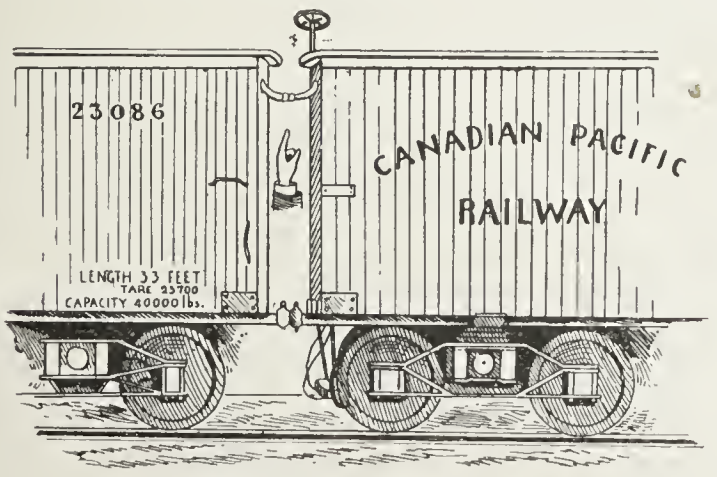
It is necessary that the mineral should be completely freed from the gangue, and this can only be accomplished by a special process. The corundum-bearing rock is first crushed, and then washed by means of sluice-boxes or revolving barrel-shaped cylinders, through which a stream of water passes. But this is not all, for if the fragments of corundum be examined, it will be found that a large proportion of them are coated with a micaceous mineral, having in many instances the composition of margarite, and resulting from the alteration of the corundum. This is removed by passing the mineral through another machine, which, in a form used at one of the principal Georgia mines contains two discs armed with points which are revolved with great rapidity, and soon wear away the soft coating. After undergoing this process the mineral is again washed, crushed and sifted to the various degrees of fineness required. Great care is necessary to prevent its reduction to "flour," as this has only a small value compared to that of the coarser grades. The purpose of all the manipulation it undergoes is to secure uniformity of hardness in the finished material.

Pending further investigation, the lands—which belong to the Crown—on which the corundum occurs in Carlow, have been withdrawn from sale by the Ontario Government, and it is hoped that the deposit will prove as valuable as the surface conditions seem to indicate. It is more than likely that this is not an isolated occurrence, but that other deposits will be found in the Hastings district, now that attention has been called to it, The circumstances attending the present discovery show that the mineral is liable to be passed over or mistaken for something else.

## DEVINE'S AUTOMATIC ELECTRIC TRAIN SIGNAL.

The recent successful tests of a new electric train signal on the freight trains of the Canadian Pacific and the Grand Trunk railways have drawn the attention of railway men to the possibility of electric city supplanting compressed air for signalling purposes on moving trains. Every one knows that the present system of signalling on freights is very defective. There is a positive need of some means of rapid communication between front and rear trainmen in cases of accident. The bell-rope is a useless ornament, and, in fact, has been abolished on many American roads. In view of the frequent accidents on freight trains within the past few months, railway managers are awakening to the fact that a change must come in the methods of signalling. To continue the present state of affairs is very unfair to employees, who have lives to save, just as it must be unprofitable to the companies themselves, who suffer yearly losses in rolling stock and freight, amounting to large sums. While compressed air is doing valuable service on passenger trains, it is doubtful whether air will ever be applied to freights for signalling purposes. It is for this reason that we call the attention of railway men to this recently patented electric train signal. It has already given proof of its value and is worth inspection.

Two insulated wires run from end to end of the train, either as a weather-proof cable, like the ordinary bell-cord, or coupled between cars by insulated couplers, as shown in the illustration. The wires are connected to bells and batteries in the caboose and engine-cab, and are combined in such manner that front and rear trainmen may signal fore and aft at any time while a train is moving, or a signal may be given to both ends from any car in the train. A code of signals is furnished that puts the driver and conductor in constant communication on the longest freight. The main feature of the signal, however, is the circuit-closing device in the coupler between the cars. It consists of two metal U-shaped prongs, embedded in insulating material, and surmounted by flexible metal tongues, which are made to draw apart, at any time, without injury to themselves. When a train breaks in two, the wires on both ends of the separated cars are automatically short-circuited, thus ringing danger signals in the caboose and engine. The recent accidents at Napanee, Iroquois and Guelph Junction, where trains broke in two, causing much damage to rolling stock, would not have happened had they been equipped with this signal.




DEVINE'S TRAIN SIGNAL.

The following extract from the North Bay *Despatch* describes itself:

"Train 115, the fast Soo freight which runs from North Bay to Sault Ste. Marie, was equipped with this signal, on the 14th inst., and was tried in a thorough manner by Supt. Bury of this division, and he expressed himself by saying that this signal supplied a long felt want. Signals were exchanged between him and engineer, and between conductor and engineer, and in no instance did it fail."

REV. PROF. DEVINE.

The inventor, Rev. E. J. Devine, S. J., is a professor in St. Mary's College, Montreal, a gentleman who has a thorough knowledge of railways and railway organization. His patent rights are still in the market. The invention is a valuable one, and has undoubtedly a prosperous future before it as a safety appliance. Its adoption would give railway companies a further motive for applying to the Inter-State Commerce Commission for an extension of time in the matter of air-brake equipment.

## STEAM, HYDRAULIC OR ELECTRIC ELEVATORS.

*Editor* THE CANADIAN ENGINEER.

SIR,—As the question of elevators for the new City Hall, Toronto, is now before the public, I think it would be in order to discuss the subject in THE CANADIAN ENGINEER. The first point to consider with reference to the City Hall is, which is the best kind of elevator for the conditions under which they are to operate, viz., steam, hydro-steam, hydraulic, or electric; the second question is, should the power be generated on the premises; third, the number of elevators; fourth, who is to get the contract.

The whole question being settled with due regard to the kind of traffic and the fluctuations of same, and due consideration being given to general surrounding conditions; the first question must be considered under separate heads, viz., first, cost, safety, reliability, economy, and cost of maintenance. The matter should be dealt with by the city the same as a private individual would deal with it. The question has been already thrashed out by two men who are considered the shrewdest business men in Ontario, and it is safe to say, they did not decide the question because they had an axe to grind; but the choice was made with due consideration of all points, and according to their condition, they chose fairly as well as wisely; the one deciding on electric, the other on hydraulic elevators. Which is the better kind of elevator for the City Hall is easily answered for several reasons, one of which requires no mechanical knowledge to understand. The manufacturers of all kinds of elevators say that the

plant for the City Hall should be hydraulic, except one, who only makes electric machines, who says it should be electric. Now, if a number of men, each tendering on both hydraulic and electric—it making no difference which side of their tender is accepted—say it should be one way, and one man who only tenders on electric, of necessity, says it should be the type he makes, he presents a conclusive argument against his machine.

*Cost.*—The cost of an elevator plant, like any thing else, can be estimated in different ways and so arranged as to mislead the purchaser. This was certainly done in the city hall tenders, perhaps unintentionally, but as the aldermen are not all mechanics it is necessary to make the matter as plain as possible. The hydraulic elevator will cost less for a complete plant to install ; it will also cost less to install the elevators without the power plant ; this is a fact, although the tenders would appear to contradict this view at first sight.

*Safety.*—First cost being less, the next reason is the hydraulic is safer than any other type, from the fact that in water you have something you know something about, and troubles from water are easily noticed, while with electric the least thing will render the plant useless The mechanism for handling the hydraulic is simplicity itself ; if the mechanism in the car is moved it moves the main valve, depending on no auxiliary machinery to do the work, and if the valve be closed the elevators will stop, this is because water is practically a solid, and it is like cutting off an iron bar with the valve, thereby positively stopping the piston, which being a slow moving body, is easily brought to rest. In the electric elevator from the time the operator starts to apply the controlling machinery there is a cycle of changes before the car is stopped that is enough to turn a man's hair gray. In the modern up-to-date electric it is more complicated than in the earlier types ; and there is more controlling mechanism to one electric than in ten of any other kind, this certainly does not tend to make it safe, for there are that many more chances of derangement. You also use power to stop the electric, as well as start and run it ; the more simply an elevator can be started and stopped the safer it is.

*Reliability.*—In this respect the hydraulic is also best, for the same reasons as make it the safest ; also the car in the hydraulic is the fastest moving part, the machinery being very slow and easily handled while in the electric the car is the slowest moving part, the machinery being very fast and complicated. It is subject to great wear and tear, and requires constant attention, the least thing putting it out of order while the hydraulic requires something to actually break to cause a shut down.

*Economy.*—The hydraulic is the more economical of the two, from the fact that with a good pumping plant of a size that will keep it working moderately steadily, that is, a pump that would be far too small if it was pumping direct to the elevator, is used pumping into a pressure tank from which the elevator takes its water ; this tank is partly filled with air, under the same pressure as the water. Under these conditions, when an elevator takes water the pressure falls in the tank a little, and the pumps slowly pump it up again to the pressure that its regulator is set for ; if a number of elevators take water together, the accumulated energy stored in the tank is given out to help the pump, and the pump stores more while the elevators are coming down. The pumps by this means are kept more constantly at work than is possible in an engine generating power for electric elevators, except possibly where a storage battery is used, and they have not been proved a success. When an elevator starts, there is no shock to the pump, as the pressure falls very gradually, due to the expansion of the air in the storage tank. Now in the electric plant the machines must be large enough to start all the elevators at once ; anything short of this is folly, and would eventually cause an accident. When the elevator takes current the shock is very great, being practically a dead short circuit for the time being ; and as there is no reserve, the shock is not only felt by the motor, but also by the generator, the only difference being, the one shock is to a standing machine, while the other is to one running. Now, it is evident to any one that to run a power plant where the average load is only a very small percentage of the maximum, occasions a loss which is much greater than in one where the mean load nearly approaches the maximum. This is the case exactly with electric versus hydraulic elevators. If the steam consumption is measured on a good pumping plant running a certain number of hydraulic elevators, and the steam consumption of an engine running a dynamo supplying current to a like number of elevators under the same conditions, then the economy will be found on the side of the hydraulic. The difficulty is, the electric men want to measure the current at the elevator for the electric plant, and the coal at the coal pile for the hydraulic.

*Maintenance.*—It is hardly necessary to take up this question, as even the electric manufacturers acknowledge it costs less in the hydraulic than in electric, and it is of necessity so, for the same reason that the hydraulic is safer and more reliable. The only thing to wear in the hydraulic is the piston and valve leathers, while in the electric the expense of keeping high-speed electric machinery in repair is considerable. Weight is added to all this by due consideration being given to surrounding conditions.

Now, sir, as to whether the power be generated on the premises or not, I say "Yes!" The city has already spent a large amount of money in putting in eight boilers, and for the city not to run its own plant is to my mind like a man who builds a factory and lets it stand idle, and buys power from some other source. One-fourth of this boiler capacity is ample to heat the buildings. So if the boilers were put in, knowing the only work they were to do was to heat the building, it was a needless expense putting in so many. In a building where people are sitting writing continuously, it is necessary to have the steam on almost all the year round in some parts of the building, and for say seven months of the year the exhaust of the pump would do this and no more fuel would be used than if the steam were used direct from boilers the balance of the year ; if the current for lighting is not generated on the premises live steam would have to be used in addition to the exhaust. If a lighting plant is put in, the exhaust from it, with the exhaust from the pump, will heat it 365 days each year, and during the time the heat is on the building it will require no more fuel than if the heat were off, if the building is piped up right—and I have no doubt it is, as the work was done by competent men.

As to the number of elevators, that will all depend on the amount of traffic, and if it is not to be greater than at the present city hall, it can be handled by three elevators, if hydraulic, with plenty of reserve for many years to come. The two elevators in the Freehold Loan building handle more passengers than the city hall elevators will have to do ; and the elevators in the Simpson and Eaton buildings handle more passengers in one hour than the city hall will have to carry in a day. However, the number of elevators is something that nobody will find fault with.

As to who is to get the contract. This is a very important matter. With a private individual, it is settled on the merits of the article, and the advantages to be derived from giving it to a particular party in the way of mutual trade, it is in some cases considered ; but it is nobody's business where a private party buys his goods, but with the city, or the country, there is also a principle involved. I don t purpose advocating the asking one man to tender, although I can produce good arguments for the city doing so ; but I do say, the city should only allow Canadian firms to tender. The way the Canadian workmen are being treated by our neighbors to the south is a shame, in the light of the manner in which we are treating them, and the only way to bring them to their senses is, when a contract is open, that we can fill as well as they can, to exclude them by all means. But apart from all that, there is the principle of giving to the people who give to you. If the work is kept in Canada, it comes back to ourselves ; if it goes out of the country, it is gone forever. When tenders were called for the new G.T.R. gates, at Niagara, the Canadian firms were told that they might tender on the gates for the Canadian side, but their tenders for the United States side wouid not be considered ; but United States firms tendering were told that they could tender for both sides, and of necessity, anyone can build four gates cheaper than they can build two, consequently, the United States firm got the contract, although the Canadian tender was really the cheapest.

It is hard to understand why our people will continually run away to some other place to get what they want when they often have better at home. If Canadian firms got the same show to do work in the United States that we give to United States firms, then it would be only right to let them tender, but the last place they come for anything is Canada. We have United States elevators in this city, both hydraulic and electric, and we have others made by a home manufacturer, and if anyone who is not a bigot and prejudiced against them, no matter how good they may be, will only go to, say, the Bank of Commerce, for hydraulic, and size up both the elevators, and the way they were put in by a United States architect, and then go to the Union Station, or Eaton's, and see the Canadian hydraulic, and the way they are installed, it will be a revelation.

*Surrounding Conditions.*—The conditions would suggest a hydraulic plant, from the fact that the city has a very very costly building, which is not fire-proof; in fact, the upper parts of which are a fire trap. This requires the best fire protection attainable, which a good elevator pump gives, because, unlike a fire pump that stands for a year, and when a fire occurs it is found to be out of order, the elevator pump is running every day, and if it is not attended to every person coming into the building will know it, on account of the elevators not running ; whereas a fire pump might be out of order, and no one would know it. And judging the city hall plant by the rest of the city, it will not be attended to any better than the law allows. The great fluctuations of traffic in a building like the city hall will be taken care of better by hydraulic than by electric elevators, because when the elevators stop the pump stops also, and all steam consumption ceases, and when the traffic is heavy the pumps will work practically all the time, but in an

electric plant the machine generating the power is running all the time, giving a percentage of loss, for it is either full load or no load. The great difficulty is that people are getting into the habit of thinking that if anything is electric it must be the best; that is true in some cases, but those who have had to do with electric elevators have found them to be Jonahs. Consumers of current usually think they are robbed, but when a man pays his bill for current for running his elevator he should laugh in his sleeve for he has got all, and more than all he has paid for. The electric elevator is a curse to a lighting station; they have hurt the incandescent lighting business more than anything else; so much so, that the Toronto company has put nearly all the elevators on a separate current. Now, if a large company has to do this, when an elevator adds such a small percentage of load to the station, it is plainly to be seen how mnch more it would affect a private plant. If the city will have electric elevators let them buy the power, as the Ontario Government does for the Parliament buildings, even if they can generate it as cheaply in connection with their lights.

Now I am by no means through with the question, but will not take up any more of your valuable space, except to say that if the city will have electric elevators, they need not go to the United States for them. The Robert Simpson Company's electric elevators are the best that are running in Toronto, and if they can handle the traffic of a department store, they can easily handle the traffic of the Court House and City Hall. I hope this matter will be taken up by engineers and dealt with in the interests of the Canadian workmen with fair play to all. Yours truly,

E. J. PHILIP.

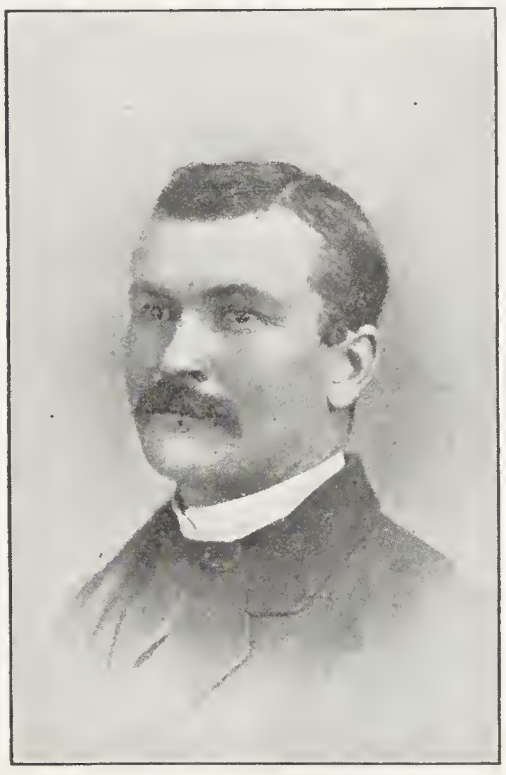
## AN UNUSUALLY LARGE ELEVATOR.

An unusually large elevator has recently been put in the new building of the T. Eaton Company, cor. James and Louisa streets, Toronto. The cylinder is 26 inches in diameter and 24 feet long; the travel of the car is 60 feet; the car is built of steel, and is supported by ten ¾-inch steel cables, and has a platform 17 feet 6 inches by 10 feet. The carrying capacity of the elevator is seven tons, which is the largest elevator with rope machinery in the city. The purpose of the elevator is to be able to run a loaded wagon on to the car, and run it off at the floor where the material is to be unloaded, thus saving handling so many times. This elevator, as well as all the 12 elevators in the company's store, were built by the Fensom Elevator Company, Duke street, Toronto. This is the largest elevator plant in Canada, and it certainly is a credit to the company. The plant is most varied in the character of the work which it performs, from the smooth-running passenger elevator, handling thousands of passengers each day, and the fast-running freights, to the slow-running direct lifts; and last, but by no means least, this mammoth, which has lately been installed. Another novel feature on the T. Eaton Company's premises is the power grooming and clipping machines in the stable, that can clean or clip a horse in almost less time than it takes to tell it. These are driven by two 2 h.p. electric motors, built by the Toronto Electric Motor Co., as also a 15-h.p. motor for cutting and grinding feed. The stable building is heated by steam and lighted by electricity, and is equipped with Grennell sprinklers (dry system), and seven hundred and fifty feet of 2½-inch standard fire hose arranged on each floor. The capacity of the stable, as arranged at present, is one hundred horses.

## THE DOHERTY IRON CASTINGS PROCESS.

The recent sale for a large sum, of the British patents of the Doherty process in iron foundry practice, will render a short description of the process of interest to our readers, especially as the discoverer is a native Canadian. The process consists in introducing into the tuyere (or mouthpiece by which the blast is brought into the cupola) a jet of steam, with the result that the casting is made finer in the grain, softer and tougher than is ordinarily the case, and this improvement applies, not only to castings made wholly from pig iron, but from scrap also, the loss being only two per cent. in some cases where scrap is used. It has long been known that humidity in the atmosphere has an effect in iron smelting, but it remained for Thomas Doherty, of Sarnia, by a happy accident to follow up this obscure and uncertain effect till the problem came within his control.

When scrap is used in a foundry a large amount of the oxide of iron is carried off with the slag and lost, this loss being about 30 per cent. in ordinary practice. The introduction of the steam jet—in which the elements of hydrogen and oxygen exist—has the effect of producing a more strict form of metallic iron through the removal of the oxygen from the oxide. In his foundry in Sarnia, Mr. Doherty uses one part of second quality foundry pig and three parts of low-grade scrap with malleable to the extent of not more than 300 lbs. to the ton, the result being a stronger, softer, and more uniform casting than can be obtained in the old way. Various foundries that have adopted the process state that they have saved from $4 to $5 per ton, according to the kind and price of raw material used. Though the principle is the same in all cases, the application of Mr. Doherty's process varies according to the work of the foundry, the iron used, and the purposes the castings are turned to, and judgment and experience will determine the success of its adoption in each case. For example, one class of pig iron may contain a certain amount of silicon, carbon, phosphorous, manganese and sulphur; and another class contain exactly the same proportions of these substances, yet the two irons will not give the same casting, although melted in the same cupola and under the same conditions. Then we must arrive at the conclusion that there must be a variation in the metallic iron, and in our present state of knowledge chemistry cannot give the character of it, and the consequence is that we are never sure of the same results, even on the same analysis. There may be a variation of 10 per cent. in strength in the castings made from the two irons. Mr. Doherty believes that the introduction of steam produces a molecular change in the casting. This should be conclusive evidence that hydrogen is a powerful reducing agent, that its influence in reduction of the oxide of iron in an ordinary cupola plays a very important part, and aside from this most valuable feature it has other valuable functions, namely, softening and strengthening the castings.



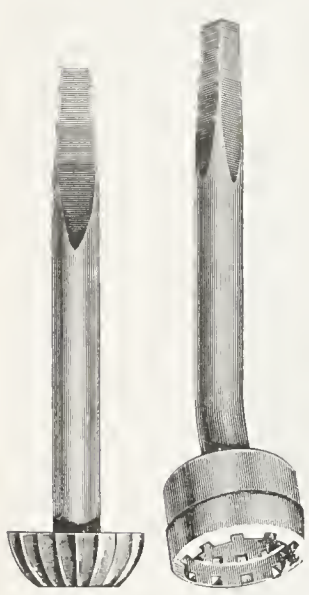
THOMAS DOHERTY.

Thomas Doherty was born near Perth, Ont., in 1854. His grandfather was a British half-pay officer, who had settled in Bathurst township, and his mother was born in Manitoulin Island, when the island was almost a wilderness. Mr. Doherty's family came to Plympton, about 20 miles from Sarnia, where they settled as farmers, but had a small shop on the farm, in which the subject of our sketch picked up with a quick instinct a knowledge of mechanical matters. They moved to Watford, where they ran a small foundry and machine shop, at which they made threshers and other agricultural implements. When Mr. Doherty was 13 years old his father died and he was left to carry on the business—a great undertaking for one so young—but he succeeded well, and fifteen years ago moved to Sarnia and established the foundry business which he still carries on in that town. It was in 1894 that he discovered the process which has made his name so widely known in the iron founding world to-day. This discovery, like so many others, was the result of an accident. The blower had got overheated, and he sent a boy up on the roof to pour water down; the water was sucked into the cupola, and its conversion there into steam had, to his surprise, a marked effect for good on the iron; he began to study the cause, and the result was the process already described. The process is secured by 21 patents in Great Britain and various countries, a company having been formed to operate in England with a capital of £100,000, paying Mr. Doherty £30,000 cash and an interest to the extent of 12 per cent. in the company. This company is known as the Doherty Iron Castings Process, Limited, with offices at 32 Victoria street, London. In the United States a company called the Doherty Iron Castings Process Co., of Ridgway, Pa., has been formed, the company paying him $150,000 for his rights. The Canadian business will be controlled by Mr. Doherty himself. It will be of interest to mention that the patents for this process at first hung in doubt in Great Britain. The claim was in the use of hydrogen "in fixed proportions," and was exactly analogous to the patents for the cyanide process of gold extraction which were being contested in the courts. Cyanide had been used before for extracting gold, and hydrogen had been used in iron melting: but

neither had been commercially a success, because a knowledge of the proper proportions had not been gained. The validity of the cyanide patents having been upheld by the highest authorities in patent law, those of Mr. Doherty's process became secure on the same grounds.

## FACING TOOLS.

T. Draper of Petrolia, Ont., manufacturer of valve facing tools and ball valves, sends us his new descriptive circular containing cuts of the tools, which we reproduce here. As will be readily seen from the cuts, the device is very simple, and it is claimed for the tools, that the work done by them is very accurate, and that valves dressed with them are perfectly tight. Only a common bit brace is required to operate them, and this is at hand almost everywhere. No more preparation is necessary than to put the tool in the brace and do the work.



SEAT FACER. VALVE FACER.

FIG. 1.

Fig. 1 shows a pair of the tools for repairing common globe valves. The seat facer or reamer is a section of a true ball or sphere, so that it makes a concave seat. The valve facer, for facing the disc, is so constructed that it makes a surface to fit accurately the surface formed by the seat facer.

Fig. 2 shows the tool for facing all flat-seated valves.

Fig. 3 is from a photo of the actual operation of repairing a globe valve.

Figs. 4 and 5 show three positions of the valve facer in its revolution, They also show the valve disc *C* jammed tight against the part *D*, to prevent it turning, while being dressed.

JENKIN'S OR FLAT SEAT FACER.

FIG. 2.

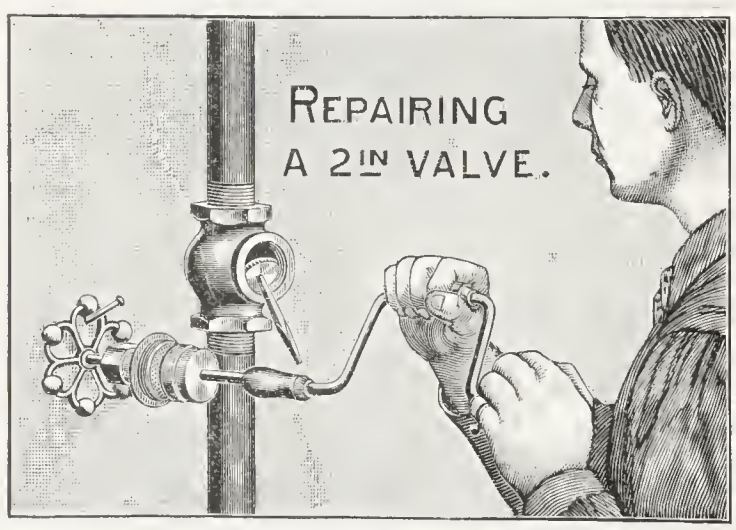



FIG. 3.

Note particularly that the tool travels in the direction indicated by the arrows. It swirls or sweeps around the disc. This pecular motion is obtained by having the driving shank bent, as shown in Fig. 5. This cup tool has an inner and an outer cutting edge, as will be seen by Fig. 1.

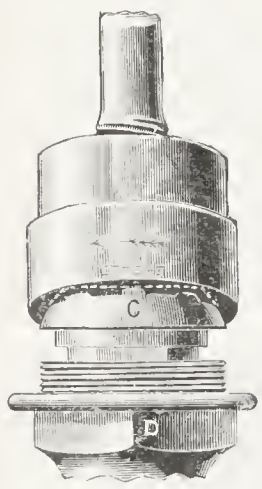



Fig 4.

These tools make practically a ball and socket joint, which is admitted to be the best form and the right principle. Mr. Draper informs us that he is continually making sales all over the United States and Canada, and that the numerous users report the tools to be very satisfactory. His advertisement will be found in another part of this paper.

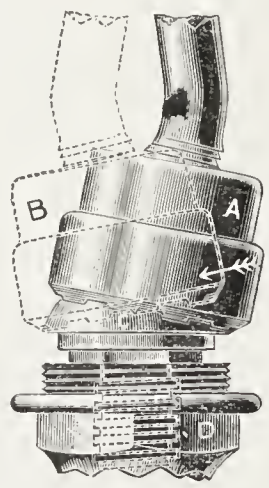



Fig 5

SPENCE & Co., file manufacturers, Hamilton, have put in a new file cutting machine, with a hammer of 160 lbs., one of the heaviest of the kind in Canada. The machine was made by Charles James, machinist, of the same city.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during October, 1896, 1897, and the ten months to October, 1896-1897.

| | Month of Oct., | | Ten months ending Oct., | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £6,296 | £7,921 | £53,163 | £58,593 |
| Pig iron | 4,974 | 1,187 | 26,204 | 6,485 |
| Bar, etc. | 1,443 | 306 | 14,049 | 7,878 |
| Railroad | 13,756 | 6,885 | 171,909 | 45,778 |
| Hoops, sheets, etc. | 6,919 | 15,307 | 42,677 | 71,261 |
| Galvanized sheets | 4,760 | 13,439 | 46,972 | 48,986 |
| Tin plates | 18,580 | 30 122 | 110,489 | 162,971 |
| Cast, wrought, etc., iron | 4,298 | 2,932 | 44,949 | 28,889 |
| Old (for re-manufacture) | 736 | 1,292 | 15,598 | 6,483 |
| Steel | 6,809 | 6,440 | 79,869 | 47,501 |
| Lead | 2,793 | 4,888 | 13,279 | 23,950 |
| Tin, unwrought | 1,861 | 1,169 | 13,577 | 14,983 |
| Cement | 6,445 | 2,880 | 31,031 | 18,491 |

## WASHING AND BRIGHTENING STONE WALLS.

W. P. M., HALIFAX.—If you have the information, will you please answer through THE CANADIAN ENGINEER, giving a method of cleaning the soot and dirt which collects on the front of large freestone buildings, without going over the building with a tool. The soot is from soft coal and is driven in with the dampness.

ANSWER.—In removing soot from stone buildings nothing is so satisfactory as chisel work. For brightening up the stone walls brushes of steel wire are sometimes used, but this process does not penetrate far enough. Various washes and enamels have been used and advertised for this purpose, but we should advise you to be very chary about their use. In most cases they are composed of dilute solutions of muriatic acid. This preparation is often used to wash brick walls as well as stone, with the result that both mortar and stone are eaten into and crumble away. In many cases where architectural work has been spoiled, these washes are the unsuspected cause. Various kinds of enamels are also used, in which case the sooty surface is covered up by the application, but this enamel soon begins to wash off in patches, making the building look worse than before. Next to tooling cut stone architecture is rubbing them down with wet bricks of "grit" composed of any sandstone, washing off after the operation.

## THE ELECTRIC RAILWAYS OF CANADA.

There are at present in Canada 569 miles of electric railway, exclusive of those of British Columbia. The valuable statistics compiled by George Johnson, the Dominion statistician, show that the train mileage run of these roads in 1896 was 21,917,151, and the number of passengers carried was 73,496,069. The total capital and bonded debt was $23,000,000. There were in use 947 motor cars, with 1,315 motors, 360 trailers, and 62 street sweepers and snow plows. The total number of hands employed was about 3,400. In the statistical year book for 1896 detailed returns are given of five electric railways reporting to the Department of Railways and Canals, as follows:

| | Miles long | Train mileage run. | Paid up capital. |
|---|---|---|---|
| Berlin & Waterloo | 2.75 | 66,000 | $28,350 |
| Ham., Grimsby & Beamsville | 17 | 207,001 | 189,700 |
| Montreal Park and Island | 14 43 | 42,653 | 770,401 |
| Niag. Falls Park and River | 13.68 | 221,535 | 1,281,731 |
| Oshawa | 8.50 | 23,258 | 311,704 |

| | Passengers carried. | Tons freight. | Earnings. | Expenses. |
|---|---|---|---|---|
| Berlin & Waterloo | 205,000 | ..... | $ 8,200 | $ 6,880 |
| Ham., Grimsby & Beamsville | 256,313 | 2,142 | 36,040 | 28,926 |
| Montreal Park and Island | 728,204 | ..... | 56,446 | 55,879 |
| Niag. Falls Park and River | 474,552 | ..... | 58,688 | 36,271 |
| Oshawa | 87,519 | 16,389 | 11,900 | 16,700 |

## SEWAGE VENTILATION.

*Editor* CANADIAN ENGINEER:

SIR,—The *Canadian Architect and Builder* for November reports a paper read by J. W. Hughes, master plumber, of Montreal, before the American Public Health Association at Philadelphia, wherein Mr. Hughes enforces the systems and ideas of drain ventilation and construction so ably described in THE CANADIAN ENGINEER of April, September, and November, by W. M. Watson, master plumber, of Toronto. This is a good sign that the dangerous sanitary plumbing and drainage by-laws forced on the public by interested and selfish

persons and law makers will soon have done all the mischief it will be allowed to do. If this should meet the eye of Mr. Hughes, I might inform him that the by-laws controlling such matters for Brantford, Ont., will probably meet both Mr. Watson, Mr. Hughes, and every sanitarian's views who works for the good of the country. It is hoped that these two experienced sanitary plumbers will encourage still more of the kind to speak the truth boldly, and stop the scandalous and expensive abuse of the public health laws.

Yours truly,

A CONSTANT READER.

Toronto, Nov. 21st, 1897.

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on Thursday, Nov. 11th, Prof. H. T. Bovey, LL.D., D.C.L., read a paper on the "Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce." The paper was followed by an interesting discussion in which Messrs. Peterson, Smith, Irwin and Duggan took part.

The ballot sheets for the election of officers for next year are now in the hands of the voting members. They are accompanied by one or two amendments to by-laws, which will probably effect some changes in the conduct of the society. Under the present laws, all past presidents are *ex-officio* members of the board; and the number will, of course, be increased yearly. The voting members fear that the control of the society may soon pass out of their hands if some change is not made, and an amendment, signed by nineteen voting members, proposes that three of the past presidents be elected to the board, instead of all as at present. The office of secretary is also the subject of an amendment. At present the secretary is always a member of council. It is proposed to separate these offices.

# Mining Matters.

THE Jenckes Machine Co., Sherbrooke, Que, reports British Columbia sales as very satisfactory.

HON. G. E. FOSTER authorises the statement that Rothschilds offered half a million for the Olive mine, half cash and the remainder in stock. The offer was refused.

J. C. MASON, Manager of the Hopewell gold mine, New G lasgow N.S., reports prospects at the mine bright. A 79 ounce brick was the result of a recent run of 21 days.

THOMAS WHITTAKER, 135 Bathurst street, Toronto, has a farm in the Nipissing district, Ont., on which he has discovered fire clay, extending over 15 acres, and ranging from twelve to fifteen feet in depth.

THE Hamilton Powder Co. is equipping its Nanaimo works with a new hoisting plant, having placed an order with the James Cooper Manufacturing Co., Limited, for a standard link motion hoisting engine.

THE Eustis Mining Co., Eustis, Que., has commenced sinking again in its shaft, and has placed an order with the Jenckes Machine Co., Sherbrooke, for special underground hoists to be worked by compressed air.

THE Winnipeg Mining and Smelting Co., Greenwood, B.C., is developing its property, and has installed a complete mining plant, purchased from the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que.

THE Bonanza Nickel Mining Co., Limited, Sudbury, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, for a 10-stamp mill, complete, with two six-foot vanners. It is the intention to install this mill immediately.

BY a recent judicial decision in British Columbia it has been decided that no matter where a mining company may be incorporated, or under what terms it holds its charter, the transfer of its pro perty in British Columbia is subject to the laws of British Columbia.

THE Sarnia *Observer* says the Bushnell Oil Company, Limited, is pushing things in Lambton county, and are thoroughly testing the territory in the vicinity of Sarnia to see if oil can be found in paying quantities. It is reported that extensive finds of both oil and gas have been made.

J. A. BOWS reports to the Bureau of Mines from Wabigoon, under date of Nov. 14, on the district lying about eight miles south of Tache Station on the C.P.R., and around Shallow, Stormy and Long Lakes, and the Little Wabigoon River. Mr. Bows says in his letter: "From all appearances, I would think that it will prove one of the richest sections of the country."

THE New Goldfields of British Columbia Co. proposes to actively take up the development of its several properties in the Kootenay district, and is, at present, opening the Velvet mine, in which there are several promising showings. It has a new hoisting engine plant installed, which was supplied by the James Cooper Manufacturing Co., through the British Columbia agent, James D. Sword.

THE new mining district in Calumet Island, Ont., on the Ottawa River, is coming to the front; there has been some preliminary work done, and on the 'Calumet" property this has opened up showings so promising, that the company has placed an order with the James Cooper Mfg. Co. for a complete drilling, hoisting, and pumping plant. Even if present indications only are a criterion, this will make one of the largest mines in Canada. The company, however, thinks that with depth it will prove even richer than the present assays disclose.

THE outlook for cheaper coal and coke in the East and West Kootenay districts is very promising; the reports from the West are that work has been proceeded with so actively on the Crow's Nest Pass Railway, that it has been graded to within 20 miles of Moyie Lake. Simultaneously, the Crow's Nest Pass Syndicate is engaged in prospecting work with the diamond drill outfit, which was ordered through the James Cooper Mfg. Co., Limited, and it is expected before the completion of the railway to have opened the property to such an extent as to supply the local demand at least.

THE absence of railway communication has retarded the opening up of the Boundary country to a great extent, but notwithstanding the difficulties that have to be surmounted in getting machinery in, several of the companies which have had enough preliminary work done to warrant their putting in a plant, have decided to haul their machinery in by wagon road. The Brandon and Golden Crown Mining Co. has decided to proceed actively with development work, and has placed an order with the James Cooper Manufacturing Co., for a complete hoisting, pumping and drilling plant, which is now on the ground. As soon as this is set up a large force of men will be put on the work.

# Railway Matters.

THERE seems to be a strong probability that the G.T.R. will double track the line from Hamilton to Niagara Falls.

THE Ottawa and New York Railway Co. have offered to build their workshops in Ottawa if they are given a bonus of $100,000.

IT is said that the G.T.R. will have running rights over the new Toledo & Northwestern Railway, thus getting into the Ohio coal fields.

THE Grand Trunk Railway Company has sent cheques to Brantford amounting to $33,500, returning the car works bonus with interest.

SHIRLEY ONDERDONK, son of Andrew Onderdonk, the railway contractor of Hamilton, has gone to Alaska to assist in surveying a railroad.

THE Tilsonburg, Erie and Pacific R. R. is constructing a connection at Tilsonburg, Ont., with the M.C.R. and will build a $20,000 steel bridge across Otter Creek.

THE Lotbiniere and Megantic Railway Company is building a wharf 160 feet long at Cap a la Roche, Que., to facilitate the shipping pulp wood, bark, etc., from that section.

A SUB-COMMITTEE of the Montreal city council has recommended the granting of part of Victoria Square, Montreal, to the Grand Trunk Railway as a site for an office building.

THE Q.C.R Company are about to extend their shops at Newington, near Sherbrooke, Que., which will require an expenditure of not less than $70,000. The contracts have not yet been let.

A CHARTER is applied for by a company which proposes to build a railway from Cranbrook, B.C., to the North Star mine, thence to headwaters of St. Mary's River, and Kootenay and Arrow Lakes.

THE T. H. & B. took control of its own road on Dec. 1. The M.C.R. officials went out and the head office was transferred from Detroit to Hamilton, Ont. The new manager is E. Fisher, of Jackson, Michigan.

AN agreement has been signed between the Nova Scotia Midland Railway Company and the Nova Scotia and Federal Governments, by the terms of which each of the latter agree to subsidize the road to the extent of $3,200 per mile, for the construction of a railway from Windsor to Truro. W. G. Reid, of Montreal, has the contract to build the road, which is to be fifty miles in length.

THE bridge over the Columbia River carrying the Red Mountain tracks to Rossland, B.C., has been tested for traffic. It is a composite structure of wood and iron of six spans, in length about 2,000 feet.

AT the present time the Grand Trunk Railway System is having the heaviest run of freight in the memory of the oldest employees. The company has ordered the construction of a thousand new cars—500 in Detroit, and 500 in the Canadian shops.

THE G.T.R. is doing a good deal in the way of improving its property. An oil house will be erected at London, Ont., and a new roundhouse at Sarnia. The new Berlin station is to be completed by Christmas, and the capacity of the freight sheds at Wiarton is to be doubled.

THE Hudson's Bay and Pacific Railway Company has applied for an amendment to their charter, to abandon the projected line from Prince Albert to Calgary, and to establish instead, the branch between Prince Albert and Edmonton, and to a point at or near the Yellow Head Pass.

AN important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville, and other places.

A CURIOUS accident occurred on the Canadian Pacific, near London, Ont., the other day. An engine was running light to the repair shops just ahead of a train, when suddenly the axles broke, the sidebars fell from the sides, and the steel tires of the driving wheels broke in several places, causing a complete wreck of the engine.

STRATFORD, ONT., demands $25,000 from the Grand trunk, which is the amount which Stratford gave the railway company to erect and maintain a roundhouse in the place, and it is claimed that the Grand Trunk is breaking the agreement with Stratford by removing engines and crews from that place to Sarnia, where a new roundhouse is being built.

MR. HEINZE and the Canadian Pacific have failed to come to terms, and Sir William Van Horne has made the following statement: "It is absolutely necessary that we should reach Rossland with a line of our own, and we are under pledge to Rossland to do so. We would have preferred the purchase of the Trail Creek road, which could have been adapted to our purposes by a considerable expenditure, but we could not come to terms, and we are now obliged to go on with our own work."

THE CANADIAN ENGINEER has received a copy of the official report of the directors of the Grand Trunk Railway Company of Canada, together with the statement of accounts for the half year ending June 30th, 1897, which shows that the working expenses have been cut down from 71.34 per cent. of the gross receipts to 67.49 per cent. of the gross receipts for the corresponding half year. This decrease means a saving to the shareholders of £55,677. While the company's passenger traffic decreased during the six months by 0.12 per cent. the freight traffic increased by 1.49 per cent.

THE following have been elected directors of the Great Northern Railway: Messrs. P. Garneau, John Sharples, Frank Ross, V. Chateauvert, T. H. Deann, Jules Tessier, and Veasy Bosweli. The annual report mentions the completion and acceptance of the ten-mile section constructed by Paquet and Fortin, from Grand Mere to Shawenegan, and a branch line built by the company and the Laurentine Pulp Company from the St. Maurice to the latter's mill. It also states that a bonus has been offered by the council of Three Rivers if the terminus and workshops of the road are placed there, and that the question must shortly be decided.

# Marine News.

JAS. PLAYFAIR & SON, Midland, Ont., will build a large tug at Midland this winter.

RYAN & MACDONALD have been awarded a contract for sections 1 and 2 on the Soulanges Canal.

STR. "JUBILEE" has been bought to run on the Pelee Island route by a Leamington, Ont., firm.

MACDONALD & MOFFAT are making satisfactory progress on the new $10,000 wharf at Pugwash, N.S.

THERE is talk of a new C.P.R. steamer for Lake Memphremagog, between Newport, Georgeville and Magog, for the coming summer.—*Granby, Que., Leader.*

THE Montreal Transportation Company launched a new steel barge at Kingston, Ont., recently.

ST. JOHN, N.B., this winter, will have the heavy freight landed on her docks; Halifax will receive the mails.

THE str. "Empress of India" is to undergo extensive repairs and alterations, at Picton, Ont., this winter.

THE steamer "Sir S. L. Tilley" is to have 60 feet added to her length of 180 feet, making her the full size of the Welland Canal locks.

THE Beaver Line Steamship Co. has chartered the "Gallia," which is about 450 feet in length, being as large as the "Parisian," and the "Bothnia."

HENRY FOLGER says there will be a daily service between Clayton, N.Y., and Montreal, next season, with the possibility of extension to Quebec and the Saguenay.

THE Dominion Government is taking steps to improve the navigation of the Rainy River. It is also understood that the Fort Frances lock is to be at once improved.

AT Kingston, recently, the locomotive works turned out and launched a steel barge, the "Coburg," 180 feet long, 35 feet beam, and to carry 50,000 bushels on a draft of 11 feet.

MESSRS. TROOP & SON, of St. John, have placed an order in England for the building of a new steel steamer. She will be 300 feet long, 45 feet beam, and will be named the "Canada."

THE str. "Stranger," running between Valleyfield and Montreal, sunk in Lake St. Louis, recently, in 25 feet of water. The hands on board managed to get ashore after considerable hardship.

WM. TWOHEY, a former lake captain, died recently in Toronto. He was in his eightieth year, and came to Canada from England in 1837. For many years he sailed between Toronto and Chicago.

THE steamer "Lakeside," St. Catharines, Ont., is to be sailed by Capt. N. J. Wigle next season, it is said, and it is reported that another boat will be put on the run along with the "Lakeside" between Toronto and St. Catharines.

SINCE his return from England, McLeod Stewart, Ottawa, announces that the building of the Ottawa Valley-Georgian Bay Canal will begin in the spring. The cost will be $15,000,000, and Sir Benjamin Baker will be consulting engineer.

IT is said at Vancouver, B.C., that the C.P.R. management intend to run the "Empress" steamers direct to Australia, by way of Honolulu and the Fiji Islands. Better boats will be put on the Japan route, and a weekly service will be substituted for a monthly one.

ROBT. BOWIE, N. Cossitt, T. Wilkinson, J. Grant, sr., D. Derbyshire, and Jas. Cumming, Brockville, Ont, are among those interested in the new boat to be built this winter for service between Brockville and Union Park, Thousand Islands. Davis & Son, Kingston, Ont., will, it is said, build the boat.

IT is proposed to build a steamer in Annapolis, N.S., this winter, to ply between St. John and points between Digby and Bridgetown, touching at Bridgetown, Round Hill, Annapolis, Grenville, Digby, Bear River and St. John. It is expected to put the new steamer in commission on April 1st, 1898.

THE Department of Railways and Canals has taken over the contract on the Soulanges Canal held by A. Stewart, Ottawa, and the work is being carried on under the control of the Government. The contract included sections 1 and 2, and comprised some heavy masonry work and the excavation and building of three large docks.

BESIDES the building of two large steamers for the Richelieu and Ontario Company for lake passenger traffic, at the Bertram Engine Works Co.'s shipyards, the iron grain steamer "Rosedale," belonging to Crangle & Hagarty, is to have a new hurricane deck. The iron steamer "Seguin," 200 feet long, will be lengthened about 40 feet.

THE Montreal papers have recently revived the old scheme of deepening the water in the channel below Montreal, not by dredging, but by building a dam at Deschambault, where the Richelieu rapids occur. This would, it is claimed, give an extra depth of eight or ten feet at Cap a la Roche, and from four to six feet extra water in Lake St. Peter.

THE new pier on the east side of the entrance to the harbor of Port Dalhousie, Ont., and the Welland Canal, the work on which has lately been successfully completed, is recently described in the St. Catharines *Journal*. It is thirty feet wide at the inner, sixty feet wide at the outer end, about five feet above high water mark, and 2,000 feet long. The first section of the work was done about five years ago by day labor, and the next year a section was let by tender to John Riley & Son, contractors, St. Catharines, who were followed next season by Battle & Newman, Thorold and St. Catharines. Last year the final section or end running into the lake was awarded to John Riley & Son. The work was under the supervision of W. G. Thompson, the resident

engineer and canal superintendent, and T. Crowley acted as overseer for the Government, with Thos Riley superintendent for the contractors. The work throughout was constructed of concrete, and cement was supplied by the Thorold Hydraulic Cement Works, estate of John Battle, proprietors.

WM. THOMSON & Co. have closed with Russell & Co., of Port Glasgow, for the construction of another steamer similar to the "Cheronea," "Platea" and "Arbela" (now building). She will be launched in April or May, and her dimensions will be as follows: Length of keel, 325 feet; breadth of beam, 48 feet; depth of hold, 26 feet 6 inches. She will be called the "Cunaxa." This vessel will be the fifth steamer added to the Messrs. Thomson's fleet.

FOUR of the passenger steamers sailing from Toronto were last season commanded by Picton men, says the *Times* of that town, namely: Captain Harry Solmes, of the new steel palace steamer "Corona"; Captain Robert Clapp, of that favorite steamer "Chicora"; Captain George O'Brien, of the favorite steamer "Empress of India"; Captain William Van Vlack, of the steam yacht "Cleopatra," also Captain Nelson Babbit, of the Toronto Ferry Company's line.

THE Bessemer Steamship Company, which is John D. Rockefeller's line of lake steamers and barges, has just closed a contract for the three largest ships on the lakes. The contract for these boats, one steamer and two consorts, was given to F. W. Wheeler & Co., Bay City, Mich., to be completed in May, 1898. The steamer's dimensions are 475 feet over all, 455 feet keel, fifty feet beam, and twenty-nine and a half feet deep. The engines will be quadruple expansion, the cylinders measuring twenty-eight, forty, fifty-nine, and eighty-five inches in diameter, with forty-two inches stroke. The barges will be 450 feet long, fifty feet beam, and twenty-eight and a half feet deep. They will carry 7,000 gross tons each. The boats will cost between five and six hundred thousand dollars. The Bessemer Company is figuring with other builders for two more boats of the same displacement for future delivery.

# Electric Flashes.

NOBLE & BARBER, electrical contractors, have started in business in Montreal.

BRANTFORD, ONT., is making estimates on a civic lighting plant. The present lighting contract expires next year.

AT a meeting of the Stratford city council last month, it was decided to advertise the electric street railway franchise for sale.

THE Royal Electric Co. is shipping the Hamilton Electric Light and Power Co. one of its single-phase 2,000 light alternators with station apparatus, etc.

THE successors to the electrical supply business of C. W. Henderson, Bleury street, Montreal, are Taylor, Telfer & Co., who will continue business at the same stand.

THE Kingsville Electric Light and Power Co. has placed an order with the Royal Electric Co. for a 50-light 6½ amp. arc machine, with lamps for lighting the streets of Kingsville, Ont.

ROBERVAL, QUE., is to have an electric light plant. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jenckes Machine Co., Sherbrooke, Que.

THE American Rattan Co. has just completed its new factory and is moving to the town of Walkerton, Ont. It has bought from the Royal Electric Co., for lighting the factory, a complete electric lighting equipment.

PREMIER TURNER, of the British Columbia Government, has stated that the Government is ready to assist the C.P.R. in constructing a telegraph line from Telegraph Creek, on the Stickeen River, to Teslin Lake, the head waters of the Yukon.

MOODIE & SON, Terrebonne, Que., agricultural implement manufacturers, have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

THE St. Jerome Electric Light Co., St. Jerome, Que., has bought from the Royal Electric Co., and is installing in that town a 50 k. w. "S.K C." two-phase alternating current dynamo, with Stanley transformers, etc. There will be 750 lights installed when it starts up.

THE Crystal Beach Electric Street Railway Company, Limited, has been incorporated. The directors of the company are: H. W. Olmsted, C. P. Olmsted, O. B. Englisch, Oakfield; H. P. Thompson, Buffalo, N.Y.; L. Beecher, Batavia, N.Y., and A. O'Heir, Hamilton, Ont.

THE Hull, Que., Electric Company has purchased the Aylmer branch of the C.P.R., which is at present under lease, the price being in the neighborhood of $100,000. Since leasing the road the Hull Company has double-tracked it from Hull to Aylmer, and improved the roadbed.

THE Hamilton, Ont., Street Railway Company's receipts have decreased considerably this year, as compared with those of last year, the decrease being attributed to the increase of bicycles in the city. The returns for the quarter ending September 30th show a falling off. The total revenue for the quarter is nearly $4,000 less than in the same period last year.

THE Canadian General Electric Co. is building a power house and a pumping station at the Peterborough works. The contracts have been let as follows: Iron and steel work, the Hamilton Bridge Co.: window frames, St. Lawrence Foundry, Toronto; galvanized iron work, Douglas Bros., Toronto.

A. G. FRASER, London, is suing the London Street Railway Company for $15,000 damages. He was pushed towards the edge of the platform, came in contact with one of the iron stays of the bridge the car was crossing, and fell a distance of about thirty feet. He claims the accident was due to the negligence of the company.

THE Windsor Electric Light and Power Co., Windsor, N.S., whose plant was destroyed by the late fire, has immediately started to rebuild, and has given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of "S.K.C." alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

GEO. C. RANKIN, London, promoter of the Chatham city and suburban electric railway, has withdrawn from the provisional company, Angus Sinclair, Chatham, taking his place. S. R. Miller and W. D. McRae, Detroit, have been elected to the board. The intention of the company is to secure the necessary amendment to their charter for the extension of the road north and south, and to push the work of construction.

THE Grand Trunk Railway has arrived at an agreement with the Hamilton Radial Railway Co. to allow the latter a crossing at Burlington, in return for the abolition of the level crossings over the G.T.R. line at Sherman avenue, and over the H. & N. W. division, near the beach. This gives the Radial a route into Oakville, Ont., and the extension will probably be built.

THE Canadian Cotton Mills Co., Milltown, N.B., has closed a contract with the Royal Electric Co. for a 30 k.w. "S.K.C." two-phase dynamo wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Manufacturing Co., Paris, Ont., and the Cockshutt Plow Co., Brantford, being the other two.

JOHNSTON'S Electrical and Street Railway Directory for 1897 will be issued January 1st. This work contains complete and accurate lists of electric lighting companies, isolated plants, telephone, telegraph, street railway, and other electrical companies of the United States, Canada and Mexico, with full information regarding each, including the names of superintendents, purchasing agents, etc.; also lists of manufacturers of and dealers in electrical and street railway appliances.

THE Deschenes Electric Company, Limited, has taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. The company, which was granted a charter in January, 1896, obtained from the Dominion Government the right to lay cables from the Ottawa River at the foot of the locks on both banks of the Rideau Canal to the canal basin, agreeing in return to supply electric current free for the lighting of the canal locks, basin, etc. The directors of the company are: W. J. Conroy, R. H. Conroy, Alex. Fraser, David Maclaren, and Charles Magee.

THE corporation of Fort William, Ont., is about to erect as complete an electric lighting plant as, perhaps, is in use in any town in Canada. There is being installed one 50-light 2,000 c. p. arc dynamo, with 35 double or all night lamps for lighting the streets of the town and the C. P. Railway yards, and for the incandescent service, and "S.K.C." alternating current dynamo with a capacity of 1,000 lights, with "Stanley" transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., Amherstburg, N.S.

IN the case of Lepitre vs. the Citizens' Light Co., we mentioned the judgment against the company for $1,000. The details of the accident are as follows: The young man was employed one evening passing wires along a beam in a cellar, under which beam were wires

charged with electricity at the time, as they served for lighting purposes. The whole space between the live wire and those at which Lepitre was working was about fifteen inches, and having come in contact with the current, he was killed. The court held that the company must be held responsible as having been guilty of negligence in not properly insulating the wires when work was being done under such dangerous circumstances.

ACCORDING to the financial statement presented to the shareholders of the H , G. & B. Electric Railway at their last quarterly meeting held recently, the railway is making money. For the months of July, August and September there was an increase of $3,125.93 in passenger receipts, $342 in freight and $1,033 in express receipts over those of the corresponding quarter last year. The total receipts for the quarter were $16,913.87, as against $12,430.91 for July, August and September of 1896. In August of 1896 , 29,192 passengers were carried, and in August of this year, 47,700 ; in September, 1896, 19,647, and September, 1897, 26,776. The expenditure for the quarter ending Sept. 30th, this year, was $2,715 01 less than for the same quarter last year.

# Personal.

WE are much pleased to hear of the restoration to health of Sir Casimir Gzowski, C.E.

H. A. J. MCLEOD, C.E., will be the Government engineer in charge of the Drummond Counties Railway.

A. R. MACDONALD has been appointed superintendent of the Intercolonial Railway between Montreal and Levis, Que.

R. J. REED, the well known contractor, Montreal, who has been ill at his home in Montreal, left for California recently in a private car.

AT the International Geographical Congress held at St. Petersburg a short time ago, Mgr. Laflamme, rector of Laval University was elected one of the vice-presidents.

JOHN CHISHOLM MACNAB, a member of the Red River expedition, civil engineer at Chatham, Ont., died at the home of his father, 111 Elgin street, Hamilton, recently. He was 46 years of age.

THE Toronto Technical School Board has appointed H. P. Elliott, a graduate of Toronto University and of the School of Practical Science, to the position of teacher of electricity and the steam engine.

GEO. H. FROST, of the *Engineering News*, New York, was a fellow student of Dr. Robt. Bell of the Geological Survey, in civil engineering at McGill University, and graduated only a short time before Dr. Bell.

THE death is announced at Jersey City Heights, recently, of Wm. Moore, a former citizen of Quebec. He was engaged as city surveyor during the introduction of the first Quebec water works. Subsequently he was first manager of the old Quebec Street Railway, when he became manager of the Quebec Steamship Company, of which, in late years, he has been New York manager.

S. J. TURKINGTON died recently in his 73rd year. The greater part of a very useful life was spent in railroad contracting. When the Grand Trunk Railway was building through the eastern portion of Ontario he superintended the construction of a large section for three years. He afterwards built a portion of the R.W. & O.R.R., the Lake Shore, the Midland, and also railroads in New Brunswick and the Southern States. On retiring from active contracting he settled in Mallorytown, Ont., and for five years discharged the duties of customs' officer, being relieved of office some three years ago.

THE death occurred at Montreal, November 14th, of Frederick Fairman, president of the Dominion Barb Wire Company. The sad event was the outcome of a cold contracted the previous week while superintending the construction of some new houses, and which developed into pneumonia. Mr. Fairman was born and received his early education in Gananoque, Ont., and graduated with considerable distinction from Victoria University, Cobourg. He entered the machinery and manufacturing firm of D. S. Abbott, Gananoque, and subsequently acquired an interest in the business, which he carried on until 1874. He was then for five years with the Montreal firm of Moreland, Watson & Co., when he bought a retail business in Waterloo, Ont. In 1882 Mr. Fairman returned to Montreal and entered into the partnership of Cooper & Fairman, which was dissolved three years later. It was at this time that Mr. Fairman accepted the presidency of the Dominion Barb Wire Company. He was also for a time connected with the Dominion Bridge Company.

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INK that will adhere to glass is produced in the following way : Twenty parts of brown lacquer are dissolved in 150 parts of alcohol and mixed with a solution of thirty-five parts of borax in 250 parts of distilled water. The mixing should be done slowly, one part of methyl-violet being added. The ink thus produced is very lasting, and can be used to advantage instead of labels on glass bottles.

# Brief, but Interesting.

THE Schwarz aluminum air ship, fitted with a benzine motor, was tested last month in Berlin, Germany, in the presence of a number of generals and others. The air ship rose to a great height, floated in the air for 12 minutes, and, at first, obeyed the man steering it, but later he was unable to steer it against the strong wind which prevailed. The experiment was considered to be partly successful.

The oldest piece of gold wire of which the world has any knowledge is a specimen made in Nineveh some 800 years B.C. Solid gold drawn wire is now, states *Science Siftings*, practically unknown in the trade. However, gold wire is made in the following manner : Silver rods are coated with gold in the proportion of 2 per cent. of gold to the weight of silver to be manipulated. When the gilding is performed the rods are about 1¾ inches in diameter by 2 feet 6 inches long, and weigh about 400 ounces each. The two metals are then drawn down together, first through steel dies, and afterward through drilled rubies or diamonds. The process of drilling the gems is kept a secret. A better idea of the minuteness of some of these borings may, however, be learned from the fact that the holes cannot be discerned by the naked eye, and only by the aid of a magnifying glass can one be convinced that they really exist. For the manufacture of silver and silver-gilt wires the silver is sometimes bored out and internal copper rods are inserted, and they are then drawn together. Wires as fine as a human hair, for example, .003 inch in diameter and even finer, can be gauged by instruments termed "micrometers." The scales for weighing the gold coin at the mint are so exquisitely fine that they can detect the most minute particle added to either side of the balance. There are fine woven wire gauzes and cloth, some of which are made with as many as 40,000 meshes to the square inch. The more delicate classes of wire find application in scientific instruments. So fine are these that it is difficult to get them measured ; but the task has been accomplished, and platinum wire has been drawn $\frac{1}{7000}$ of an inch, and to even greater fineness. Aluminum wire has been drawn as fine as 10,500 yards to the ounce, a size too fine to be practically measured by any gauge or instrument.

# Industrial Notes.

THE new flour mill at Goderich, Ont., is now in operation.

A START has been made in erecting the new flour mill at Wolfville, N.S.

A NEW $10,000 school building is to be built at once at Sackville, N.B.

A SEWAGE system for Pembroke, Ont., to cost $16,000, is under consideration.

AN engine is being placed in the Granby, Que., Rubber Co.'s machine shops.

THE E. B. Eddy Co., Hull, Que., is spending $20,000 in perfecting its fire protection system.

THE plant of the Vulcan Iron Works Co., Winnipeg, has been bought by John McKechnie.

JOHN BERTRAM & SONS, Dundas, are very busy building heavy machinery for shipping abroad,

THE Boys' Home, Montreal, has received donations amounting to $8,000 to be expended in building.

FAVORABLE progress is being made on the piers for the Saskatchewan bridge at Edmonton, N.W.T.

J. HONEYMAN and E. J. Watson, architects, are employed on the new school building, Rossland, B.C.

A BRIDGE to cost about $10,000 is proposed to connect Sydney, Cape Breton, with the Intercolonial pier.

AMONG the busy Hamilton concerns is the machine shop of Charles James, who is now turning out, among other work, 2,000 shoes for seed drills for the North-West. This firm has just put in a new 30-inch drilling machine from the well-known tool makers, John Bertram & Sons, Dundas, Ont.

THE Cappison Pipe and Boiler Covering Co. have recently supplied their Standard Abestos Magnesia sectional covering to various concerns, the orders aggregating nearly 12,000 feet. Among the mills so fitted up are the new mills of the Holland & Emery Lumber Co., who have recently removed from Michigan and built two large saw mills at Byng Inlet, on the site of the mills of the Georgian Bay Lumber Co., burnt some time ago. The new mills are fitted with band saws, circular saws, lath and shingle saws.

ANNAPOLIS, N.S., has had plans for a sewage system prepared.

THE Granby, Que., last works are putting in a forty-five horse-power boiler and engine to run their works.

THE city of Sherbrooke, Que., and the Street Railway Co. will build a new bridge over the river St Francis.

WM. DAVIES & Co., Toronto, propose to establish a large pork-packing establishment in the Maritime Provinces.

A. THOMS, Fort William, Ont., has invented a seat for use in locomotive cabs which has a special arrangement of springs.

THE Jenckes Machine Co., Sherbrooke, Que., is building a 20 x 10 crusher for the Wilson Carbide Co., St. Catharines, Ont.

B. MOONEY & SONS, St. John, N.B., have received a contract for a brick block of five buildings for T. R. Davison, Windsor, N.S.

THE Windsor, N.S., Foundry Co. has secured temporary premises and is carrying on business almost as usual. The works will be rebuilt.

PLANS have been prepared for the erection of a new theatre and opera house near St. John's gate, Quebec city. Its estimated cost is $60,000.

THE town of Kingsville have taken over the natural gas plant, which has been operated by a private company. The price was $18,000.

JAS. KAY, Aylmer, Que., has been appointed boiler inspector and issuer of engineers' and firemen's certificates in the Province of Quebec.

I. MATHESON & Co., New Glasgow, N S., have recently shipped several car loads of buoys to the Pacific coast for the Dominion Government.

GEORGE MCARTHUR, St. John, N.B., has been awarded the contract for building Doran's Hotel, Windsor, N.S. The price is over $20,000.

AT the next session of the Ontario Legislature, the city of Toronto will ask an amendment of its charter enabling it to carry on the business of cold storage.

IT is said to be probable that the McClary Manufacturing Co., London, Ont., will establish a branch for the manufacture of enamel ware in St. John's, Que.

E. METHOT, of Cap St. Ignace, is intending rebuilding his saw mill and installing two 40 h.p. boilers, to be furnished by the Jenckes Machine Co., Sherbrooke.

THE city council of Sherbrooke is passing a by-law to raise $35,000, of which $15,000 is for a new bridge and $14,000 for the completion of the sewage system.

THERE is a good prospect of an hospital being built at Maniwaki, Que., as $10,000 has been raised already, and the Quebec Government is expected to make a grant.

GEO. ANDERSON, Canadian Trade Commissioner to Japan, reports a great demand in that country for boilers, engines and machinery generally.

MONTREAL manufacturers are to be obliged to abate the smoke nuisance. Where electric power is so easily obtained as in Montreal, there should be no trouble from smoke.

PETER REID, of Lemesurier, Que., is installing a new engine and boiler, bought from the Jenckes Machine Co., Sherbrooke, which will largely increase the capacity of his sawmill.

SPENCER & SPENCER, Frelighsburg, Que., are enlarging their sawmill, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, for a 25-inch special Crocker turbine.

THE city of Hamilton, Ont., is offering the Heinze Pickle Co., Pittsburg, tax exemption for ten years and a reduced rate for water supply for the proposed Canadian branch.

THE Toronto Cold Storage Company, Limited, has been incorporated. The incorporators are: F. C. Jones, G. B. Jones, H. F. Darrell, Sarah Darrell, J. Massie, Toronto.

THE acetylene gas machine recently installed by James Boxall, in the R. C. Presbytery, Downeyville, Ont., has been tested, and gave satisfaction. It is a 20-light machine

THE Grand Trunk Railway has come to an agreement with the town of Collingwood, Ont., for the erection of an elevator there. The town will give twenty-five thousand dollars.

H. R. MCLELLAN, known as the pioneer lumberman of the Gulf of St. Lawrence, will shortly establish a lumber mill on the Marguerite River, where he controls large timber limits.

J. W. WURTELE & Co., Ottawa, Ont., are making magnabestos sectional covering, which is claimed to effect a saving of 25 to 40 per cent. in fuel, by covering boilers, furnaces, etc.

BUILDING operations have not been begun by the Hamilton and Toronto Sewer Pipe Company, Hamilton, Ont., and it said that the company does not propose to build till next spring.

THE Victoria Foundry Co., Ottawa, Ont., manufacturers of water wheels, power house plants, rotary pumps, automatic hose reels, etc., report business improving and the general outlook bright.

THE business of Rogers, Robertson and Co., oil merchants, Montreal, has been amalgamated with that of the Bushnell Company, Limited, and Duncan Robertson becomes connected with the latter firm.

GILLIES BROS. are not only rebuilding their saw mills at Braeside, but will shortly build one at Madawaska, Ont., on the K. & P.R.R., for the manufacture of cedar ties, shingles, basswood, elm and ash lumber.

W. H. MELDRUM has purchased the Paris rollers mills, at Paris, Ont., from Crane & Baird, of Toronto and Montreal. Wm. and J. G. Greey, Toronto, mill furnishers, are putting in plant of 200 barrels capacity.

THE Royal Victoria Hospital, which Lords Mountstephen and Strathcona presented to Montreal, at a cost of $2,000,000, has already grown too small, and the governors are considering plans for a $100,000 extension.

THE Canadian Engine and Locomotive Works, in Kingston, have been notified that they will get the contract to build three locomotives for the Intercolonial Railway Company. The company will tender for seven more.

THE Chicoutimi Pulp Co., Chicoutimi, Que., have decided to extend their mill, and have placed an order with the Jenckes Machine Co., Sherbrooke, for nine 10-plate screens, an additional Crocker turbine, and a 50 h.p. boiler.

THE Brothers of the Sacred Heart of Arthabaska purpose erecting a college building a hundred and fifty feet long, fifty feet wide, and four stories high, at St. Hyacinthe, Que. It will be built of stone and brick, and will cost about $50,000.

W. H. PERRIN, O. Carss, A. Foster, A. Patterson and J. R. Lavell, Smith's Falls, Ont., have been incorporated as The Perrin Plough Company of Smith's Falls, Limited, to manufacture agricultural implements. Capital nine thousand dollars.

THAT Canada may develop a large export trade in paper to Japan is evident from the fact that Taylor Bros., of the Don Paper Mills, Toronto, recently received an order from a Japanese importing firm at Yokohama, for 110 tons of paper.

THE firm of Major Bros. & Co., Montreal, manufacturers of cardboard, tar paper, etc., contemplates moving to Cornwall, Ont. They would need a site of ten acres, with a water-power, and would build a paper mill employing forty to fifty hands.

BUSINESS is very brisk at the Calcium Carbide Works, Merritton, Ont. A car load of carbide was shipped recently to the Yukon, via New York, where it will be shipped around Cape Horn. Three car loads were also shipped to Europe and one to Mexico.

THE provisional directors of the Duryea Motor Co of Canada, Limited, which is applying for a Dominion charter, capital $250,000, are: S. Rogers, T. Eaton, Toronto; H. Edwards-Ficken, New York, U.S.; G. H. Hewitt, Springfield, Mass., and G. W. Yarker, Toronto.

PRICE BROS., Quebec, have placed an order with the Jenckes Machine Co., Sherbrooke, for one of their special refuse burners, 18 feet in diameter, 120 feet high, for their Montmagny mill. This is the second burner of this size which the Jenckes Company has supplied them.

THE city council of Brantford, Ont., has voted $15,000 to buy from the Verity Plow Co. the premises recently burned. If the company accepts this offer, it will be obliged to go on with its business in Brantford. The works began to run regularly after the fire on Nov. 13th.

LAWN FARM, Mattoon, Ill., consisting of 250 acres, has been sold for $17,450 to Grand Chief P. M. Arthur, in trust for the benefit of the Brotherhood of Locomotive Engineers. It is the intention of the Brotherhood to establish a home for dependent engineers, their widows and orphans.

THE boiler of the Royal City saw mills, Vancouver, B.C., exploded at noon recently while the men were eating dinner around it. Several men were killed and many injured. The roof of the mill was blown off and the building wrecked. The noise of the explosion was heard outside of the city limits.

THE Acetylene Lighting Company, Limited, applies for a Dominion charter to carry on a lighting business in London, Ont. Proposed capital, $15,000. The incorporators are: W. J. Stinson, London, Ont.; C. S. Grosch, S. G. Grosch, Milverton, Ont.; M. M. Stinson, London; W. R. Stinson, St. Thomas, North Dakota, U.S.

THE large Jewell filters for the town of St. Hyacinth are being installed. These filters were built throughout by the Jenckes Machine Co., of Sherbrooke, and the work reflects great credit on this firm.

H. ROBERTSON, J. Arnett, D. McLean, A. Spicer, I. Groh, W. E. Roark, J. A. Rourke, R. Simpson, H. F. McDonald, T. Cain, A. Robertson, J. F. Snowball, Shallow Lake, Ont., have been incorporated as the Shallow Lake Woodwork Manufacturing Company, Limited. Capital five thousand dollars.

THE purchase of a controlling interest in the Vancouver Gas Works by Wm. Mackenzie, of Toronto, on behalf of a strong syndicate, is of interest and importance to our province's mining, says the *Mining Critic*, in view of the necessarily close connection of successful gas production with coal mining.

G. A. LANDON and F. A. Landon, manufacturers, and E. B. Landon, traveller, of Toronto, and James H. Taylor and James Kellam, of Etobicoke, farmers, have letters patent to manufacture carriages and carriage supplies, under the name of the Carriage Specialty Co., of Toronto, Limited; capital, $20,000.

THE work on the Lawrencetown, N.S., water system is nearly completed, and will cost about $9,000. Two reservoirs have been constructed, the upper one at an elevation of 250 feet and the lower one 135 feet. The capacity of the latter is nearly 100,000 gallons. Twelve hydrants will be placed in town and about fifty house services put in.

THE Goderich Boiler Works recently turned out a ditch digger, built somewhat after the plan of a dredge, having an endless chain on which are a number of knives and iron buckets. It is some 20 feet high and mounted on trucks 20 feet long and 10 feet wide. It was run by a threshing machine engine, and in clay or sandy soil made excellent time.

THE plans for the Nepean Point Bridge have been prepared under instructions from H. J. Beemer, president of the Ottawa and Gatineau and Pontiac and Pacific Junction Railways. Mr. Beemer has sent copies of the plans to various bridge contractors in Canada and the United States, and will ask for tenders at once.

ONE of the largest penstocks ever used in connection with the development of water powers in Canada is being built at the works of the Laurentian Pulp Co., Grande Mere, Que., on the St. Maurice River. The main penstock is 14 feet in diameter, made from 7-16 in. steel plate, 550 feet long, and with its branches has used in the neighborhood of three hundred tons of plate. The Jenckes Machine Co., Sherbrooke, Que., has this contract.

A PORTION of the assets of the Young Co., Limited, of Brampton, Ont., Soil Pipe Foundry, amounting in value to $7,700, has been sold to the Toronto Hardware Company by the assignee, F. H. Lamb, of Hamilton. The building and plant remain unsold, and it is said that it is likely that the town of Brampton will have to take it over and add it to the collection of such things they have acquired by their system of liberal bonus giving.

ST. LAWRENCE Anchor Fence Company, Limited, applies for a Dominion charter to manufacture fences and gates, etc., in Montreal. Proposed capital, $20,000. The incorporators are: G. F. Benson, D. W. Campbell, W. L. Chipchase, G. J. Crowdy, W. Ewing, P. Galibert, J. L. Gilmour, E. K. Greene, W. A. C. Hamilton, J. Johnston, G. W. Lovejoy, M.D., F. G. Lyman, and Hon. A. Thibaudeau, Montreal; A Dickson, Longue Pointe; J. M. Elder, M.D., Westmount, Que.

THE machinery of Paxton, Tate & Co., mill machinery manufacturers, Port Perry, Ont, has been sold to Adison Williams. This was nearly all the available assets of the firm, and, owing to secured claims, the ordinary creditors will receive nothing from the estate. The assets are expected to realize about $7,000, with liabilities of over $4,718.69, of which $1,103.59 are preferred securities held for $8,169.06. The Ontario Bank holds a secured claim for $6,900.

AT the sixth annual meeting of the Foundrymen's Association held at the Manufacturers' Club, Philadelphia, November 3rd, there was read a paper on the subject of "The Practical Value of the Various Metalloids in Cast Iron," by Malcolm McDowell, 606 E. 46th street, Chicago, Ill., who has a national reputation as a metallurgist. His paper was full of interest, and treated on the so-called semi-steel that is now being made by several foundries from cupola metal and poured in green sand; its tensile strength being about 40,000 lbs.

**SITUATION WANTED** by young man, 22 years of age, as salesman, to travel Maritime Provinces. Have traveled three years with bicycles. Good references. Address I. E. CORNWALL, St. John, N.B.

**KLONDIKE** A mechanical engineer of steady habits and general experience, going to the Klondike in the spring, to take up and work a claim, is desirous of meeting "a mate." References exchanged. Address "BOB," care of Canadian Engineer, Montreal.

**SITUATION WANTED**—Young man, practical machinist, at present engaged in the editorial office of a mechanical newspaper in New York, desires similar position with Canadian publication devoted to the same interests. Stenographer (speed, 150 words per minute) and typewriter. Age 24 years. Address M. C., care Canadian Engineer.

# For Sale Cheap

**A New 100 Kilowatt 125 Volt Muitipolar, Direct Current Dynamo**

latest steel frame type, with iron clad armature.

A most complete set of Station Attachments. Suitable for Incandescent Lighting, with a capacity of 2,000 16-candle power lamps, or for power or electro-chemical purposes; has never been used only for a test.

For particulars apply to E. H. HILBORN, 74 Brunswick Avenue, Toronto, or to JOHN TOLMIE, Kincardine.

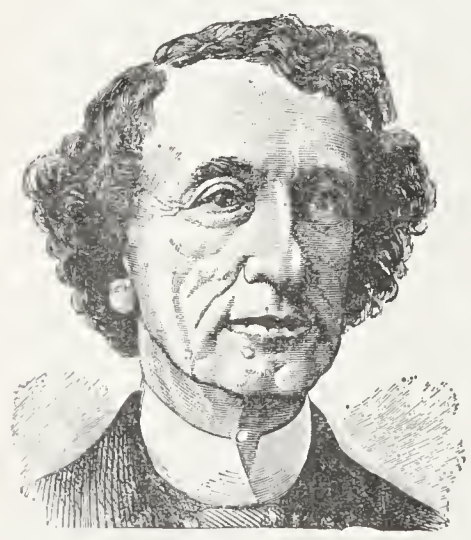
**The Ontario People's Salt and Soda Company, Limited**

# The Londonderry Iron Company, Limited

THE DIRECTORS of the above company having authorized us to negotiate for the disposal of its extensive properties and works at or near Londonderry, N.S., we are prepared to submit a schedule and to treat with reliable parties. The properties consist of about 30,000 acres of selected mineral lands held in fee simple, free of royalties, besides a further extent of mining rights, two blast furnaces completely equipped, two ore calcining kilns, sixty-seven coke ovens, a large rolling mill, a pipe foundry, a general foundry, a well equipped machine shop, about twelve miles of railway. with four locomotives, cars, etc., etc., numerous houses and all the plants incidental to the production of iron on a large scale.

**MACDOUGALL BROS., Montreal**

# A BETTER CHRISTMAS GIFT



62 Church Street, Toronto,
or Fraser Building, Montreal.

Could not be given to the old folks than a copy of "The Anecdotal Life of Sir John Macdonald." It is at once the most interesting biography and the best collection of his jokes, repartees and witty sayings ever published. As one of the reviewers put it, "it is a biography, joke book, history and anecdote book all combined in one." No Canadian work has had so large a sale in the book trade. "The Anecdotal Life of Sir John Macdonald" (330 pages, cloth, with illustrations) is now out of print and scarce. A very small number of copies have been recovered and may be had at $2 00 post-paid. They will not last long, so write quickly.

Address **Biggar, Samuel & Co.**

# The Canadian Engineer

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## The Canadian Engineer.

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### CHAP. V.

### ROADBED CONSTRUCTION.

### ARTICLE 18. LARGER WATERWAYS WITH HEAVY EMBANKMENTS.

When a single box culvert 4 by 5 feet in cross section or, with very long covers and corbels, possibly 5 by 5 feet, will not carry the maximum flow of a stream, we must either use double or treble box culverts or an arch culvert. The intermediate walls of double box culverts may be made pointed to divide the flow of water, and a screen or paling may be erected some distance up stream to catch driftwood, but, even at best, their use is doubtful for the same reasons as for double lines of culvert pipes, *i.e*, the danger of logs, etc., choking up the entrance; whether an arch culvert of equivalent area will be cheaper than such a structure will depend on the availability of brick, cement or cheaply-cut stone for arch sheeting on the one hand, or of large-sized stones for covers on the other.

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

### ARTICLE 19.—ARCH CULVERTS.

The selection of materials for the construction of arch culverts will depend on circumstances; where good weathering stone can be easily quarried and cut in the vicinity it will be usually used, but if stone is scarce or costly, and well-burnt brick plentiful, then brick may be found cheaper; of course brick so soft as to be unable to stand erosion or frost should never be used on exterior faces or for the arch sheeting. The use of concrete for arch culverts is yet a very occasional one in America, but is likely to steadily increase as we have more skilled civil

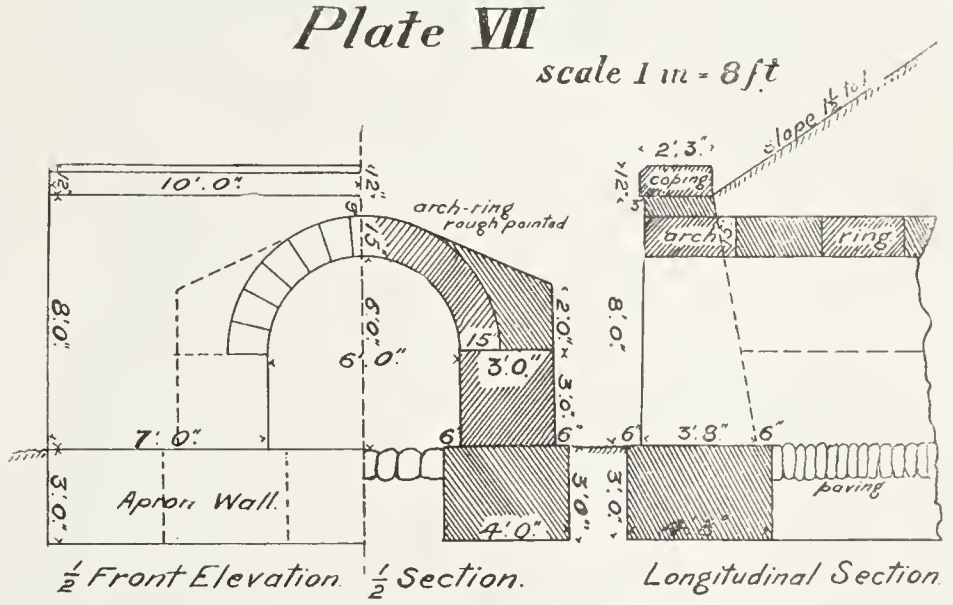



Fig. 33. 6' Stone Arch.

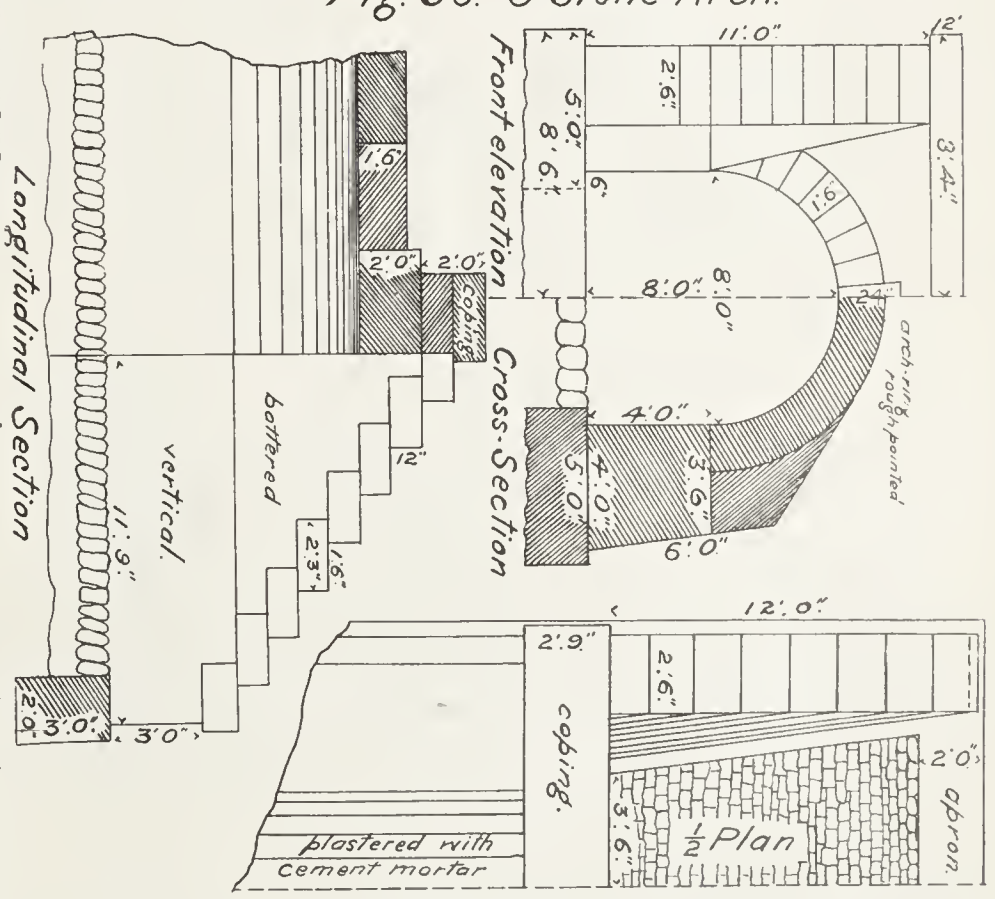



Fig. 34. 8' Stone Arch.

engineers who are familiar with the production of a cheap concrete with superior exterior finish, capable of standing frost and erosion and certain to remain sound for an indefinite number of years, which necessitates using absolutely sound, high-grade cements, and until an engineer has the opportunity of making certain of his cement by systematic testing, he is advised to avoid the use of any but the very smallest monolithic arch culverts, although, of course,

their construction presents no structural difficulties, beyond the precaution of defining occasional lines of separation in the arch sheeting so as to avoid irregular contraction lines.

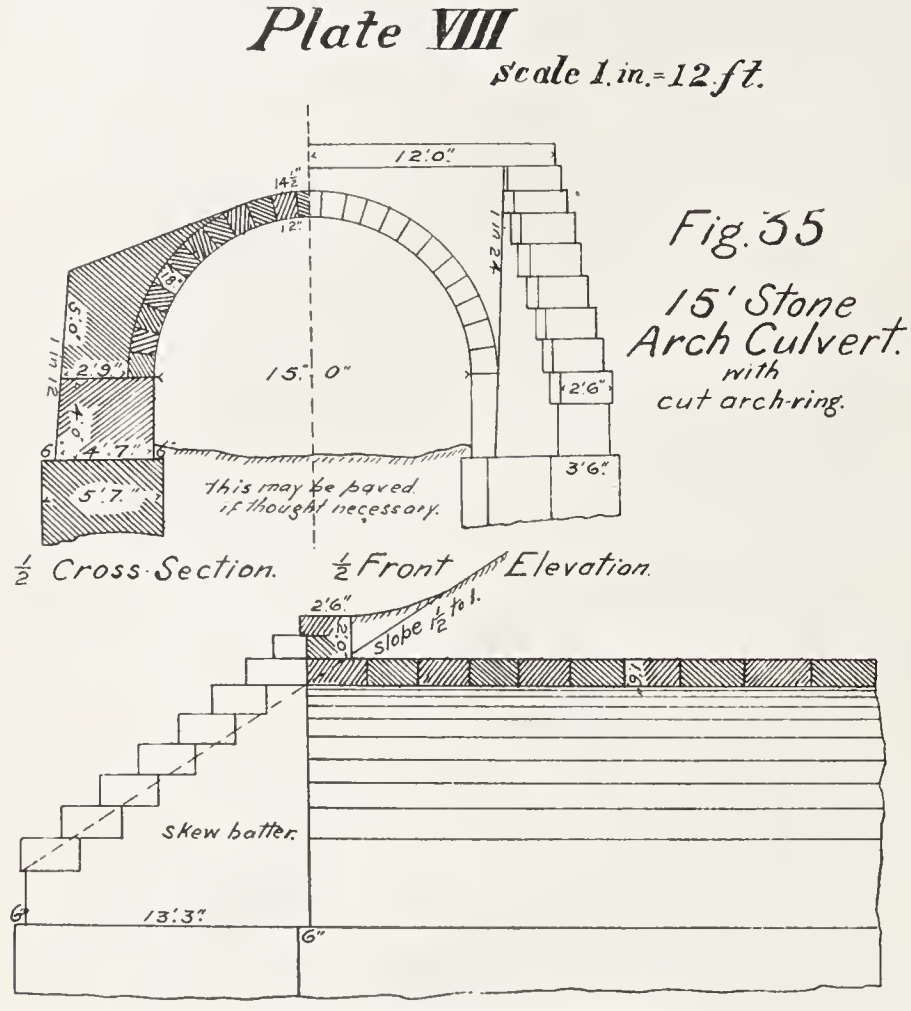



Fig. 35
15' Stone Arch Culvert with cut arch-ring.

The chief features of arch culvert designing are:—

(*a*) The shape of the end walls.

(*b*) The depth, class and form of the arch sheeting.

(*c*) The dimensions of the arch abutments.

(*a*) The shape of the end walls will depend on the span of the arch and its rise.

For small semi-circular arch culverts, say from 5 to 8 feet span, the retaining head-wall shown, Plate X., Fig. 39, and Plate VII., Fig. 33, is generally used; for segmental arches of somewhat longer span the same may be advantageous, but as soon as a larger retaining wall becomes necessary its use should be abandoned in favor of stepped wings; the reason for this is that a surcharged retaining wall, with nothing but mortar to bond it to the back of the ring stones and often loaded with wet, slippery clay filling, is liable to be displaced, unless made very heavy, and thus the designs, as shown, Plate VII., Fig. 34, and Plate VIII., Fig. 35, of the types shown on Plate X., are found more suitable. The choice between straight wings and flaring ones, or between wings flush with the faces of the barrel of the arch, and those set back clear of the ring stones will depend much on the taste of the designer; for small spans liable to catch driftwood the choice should rest on flush wings, with some flare to avoid contraction, but with larger spans, of say 15 feet or over, a wing set back so as to show the arch ring stones will have a better appearance, and give equally good or better bond between the wing and the abutment or parapet wall. The small parapet wall of a culvert with stepped wings is well buttressed and very stable; the wings themselves usually have a face batter of 1 in 12 to 1 in 24, and a section at any point suitable for a level retaining wall (*i. e.*) about $\frac{4}{10}$ height + batter, their length will be economically curtailed at a point where the steps are 2 feet or 3 feet above the ground level. Stepped wings are preferable to those with inclined copings, as the latter are liable to become dislodged in time, and do not give an easy means of climbing the bank, and, also, the coping of a parapet wall of a brick arch culvert should preferably be a stone one, as bricks are liable to be displaced by ties, boulders, etc., rolling down the bank.

(*b*) The form of the arch will depend on the depth of bank; wherever headroom permits, a semi-circular arch is used, partly because the arch sheeting stones are less expensive than those for any other than segmental arches, being all cut from one template, and partly because the abutments need not be so heavy; but as the quantity of cut arch sheeting is greatest in a semi-circular arch the saving is not very great on the structure as a whole, but when the depth of bank is the limiting feature, a much greater waterway can be obtained by the use of arches of small rise to span, elliptical, segmental, or basket-handled, at a slight increase in cost. In small arches, it is cheaper to use roughly cut or even rubble arch sheeting of a greater depth, than to build one of first-class cut stone of less depth; but as the span increases, the economy of carefully cut and bedded arch sheeting will point to the use of the minimum depth. The workmanship on stone arch sheeting should be of the quality figured on, and if cut stone is called for, it should be as shown in the upper diagram of Fig. 40, because if left narrow at the back, the mortar that fills up the discrepancy being weaker and more compressible than the stone tends to throw excessive loads on the inner faces of the stones; this is a point over which too great an amount of inspection can hardly be given, especially if the stones are of minimum depth. When deep rubble arch sheeting is used, the mortar will be strong enough to stand the pressures allowed.

## Plate IX

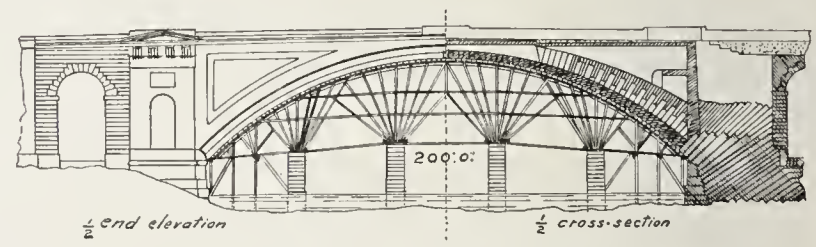



Fig. 36 Segmental Arch. with centres still in place

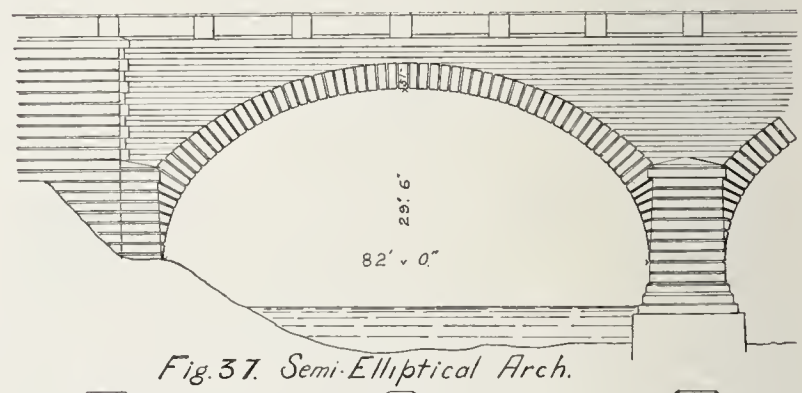



Fig. 37. Semi-Elliptical Arch.

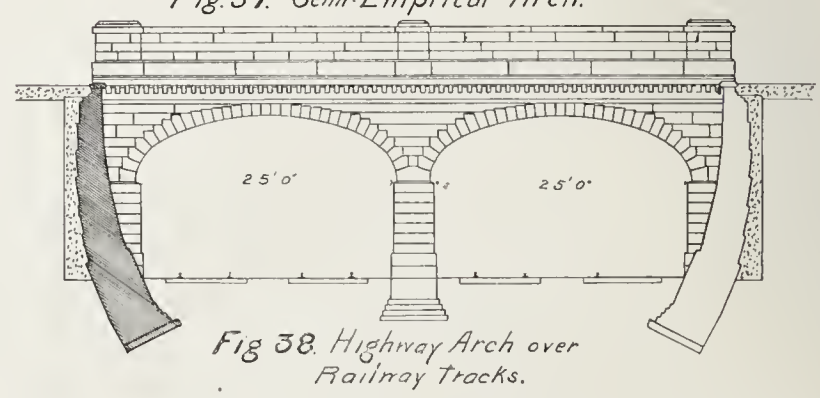



Fig 38. Highway Arch over Railway Tracks.

If arch sheeting is of brick a greater depth must be allowed usually than for stone, unless the brick is of very good quality and well bonded, and as bricks are not usually made bevelled unless for a very large contract, and are all of a uniform size, the bonding of the several rings of brick in arch sheeting of several bricks in depth is not possible except at arbitrary intervals, depending on the curvature, when the outer ring is one brick thickness behind the ring inside it, at which point a header is inserted; for a circular arch this is about once every 33° of arc and is independent of the span. Longitudinally both brick and stone arch sheeting should be well bonded also, and after the arch has been completed and the centres removed, a heavy coat of cement mortar (1 to 1) should be plastered over the back of the arch down over the haunches or spandrel filling so as to prevent percolation through the joints. In construction of the arch and spandrel masonry the two sides should be carried up at about equal rates, as a heavier load on one side will tend to push over the timber centres.

(*c*) Arch abutments need not be made of such an expensive class of masonry as that of the arch sheeting. A rock-faced ashlar about equal to second-class bridge masonry is suitable, and in designing their dimensions due regard must be had to the character of the filling behind the abutments and the depth of filling over the crown.

There cannot be said to be any fixed law by which the dimensions can be determined. The various theories advanced disagree in vital points. Some take account of the horizontal thrusts tending to increase the stability of the abutments, and some do not; some attempt to allow for rolling loads, and others use only a uniform quiescent load. It may be said in general, that for small arches where there is a large margin of safety allowed, and under heavy banks where rolling loads have little effect, the dimensions as given by Trautwine are satisfactory, but where it is deemed necessary to construct a curve of pressures, Scheffler's theory of least crown thrust and neglecting horizontal forces errs on the side of safety and is easy of application; and in constructing curves of pressure taking the point of rupture as the critical point it will be noticed that these curves pass rapidly toward the back of the arch sheeting into the haunch filling before they reach the springing line, when a uniform depth of sheeting is used equal to the depth necessary at the keystone, or slightly greater; this makes it evident that there is no such thing as a semi-circular arch, but that a segment of about 120° (60° on each side of the vertical) is a true arch and the remainder is really a part of the abutment, and for this reason the spandrel (haunch filling) masonry should be carefully constructed near the springing line and of as good a class of masonry as the face walls; higher up, however, it may be of rubble masonry as its weight is its only function.

The foundations of arch abutments are a very important consideration, as a very slight settlement will derange the curve of the arch and endanger its stability. If the foundation bed is not found to be uniformly good after careful testing with an iron bar, the best way to distribute the pressure is to lay a foundation course of concrete, or piles and concrete, if the bearing power of the soil is not found sufficient

## Plate X

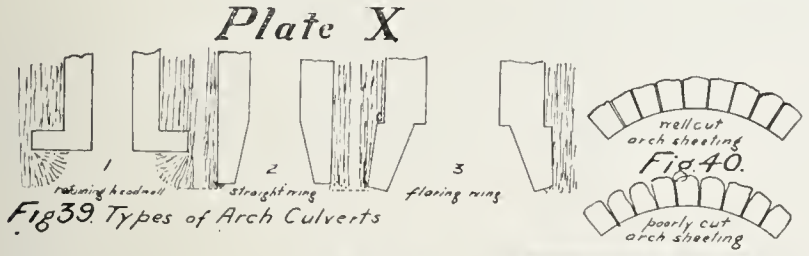



Fig. 39. Types of Arch Culverts

Fig. 40.

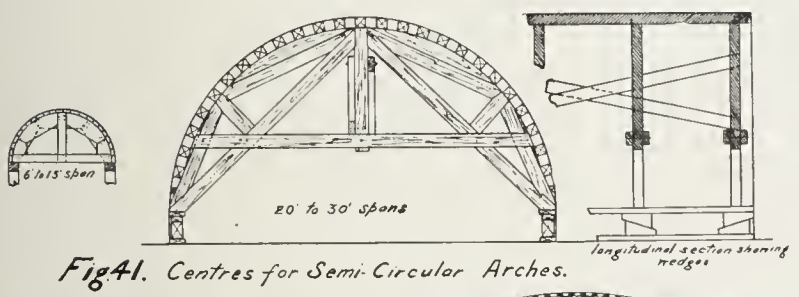



Fig. 41. Centres for Semi-Circular Arches.

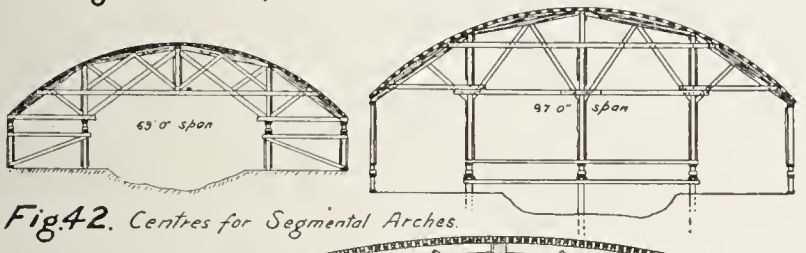



Fig. 42. Centres for Segmental Arches.

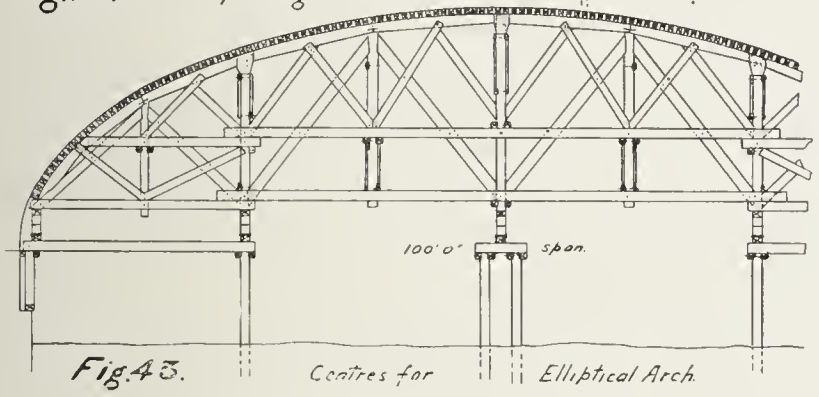



Fig. 43. Centres for Elliptical Arch.

## Plate XI

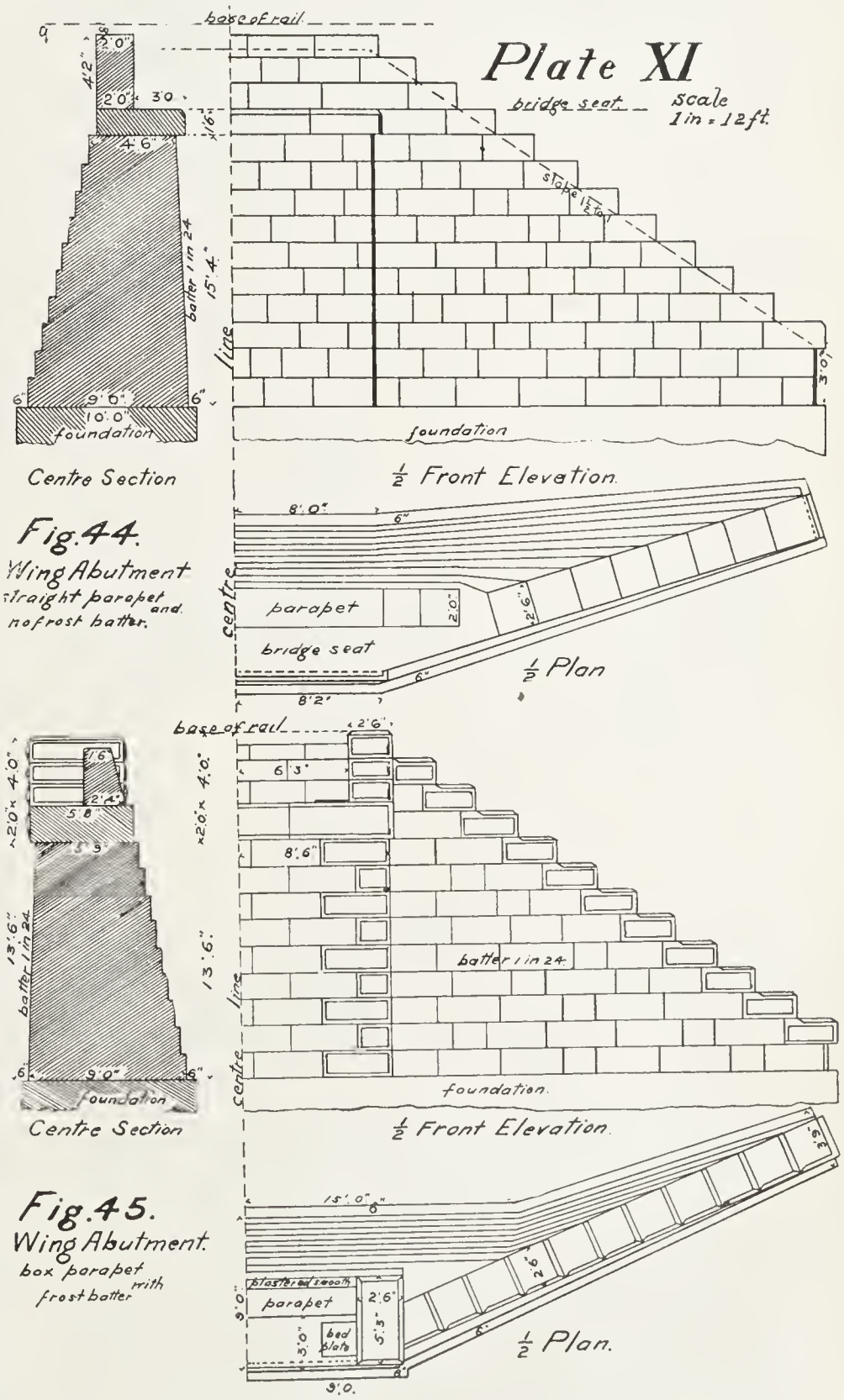



Fig. 44. Wing Abutment straight parapet and no frost batter.

Fig. 45. Wing Abutment box parapet with frost batter

### ARCH CENTRES.

To support the arch sheeting during construction and give the correct form to the arch a series of timber seg-

ments with an exterior covering of longitudinal strips or timbers is used, until the keystones are inserted. They should be designed for the weights they are to carry and rigidly supported so that absolutely no settlement may occur. But at the same time each point of support should be either on wedges that can be slackened, or on cylinders filled with sand that can be drawn off gradually at the proper time. Soon after the keystones have been inserted the easing process should begin and should be in two stages. First, a slight easement sufficient to bring each joint under pressure, and in a week or two later when the mortar has become hard they may be gradually and uniformly lowered so as to throw all the load on the arch. Figures 41, 42, 43 and 36 illustrate types of centres, and the wedges are shown in Fig. 41.

*Specification for Stone Arch Culvert Masonry.*—It will be laid in cement mortar of approved quality, the

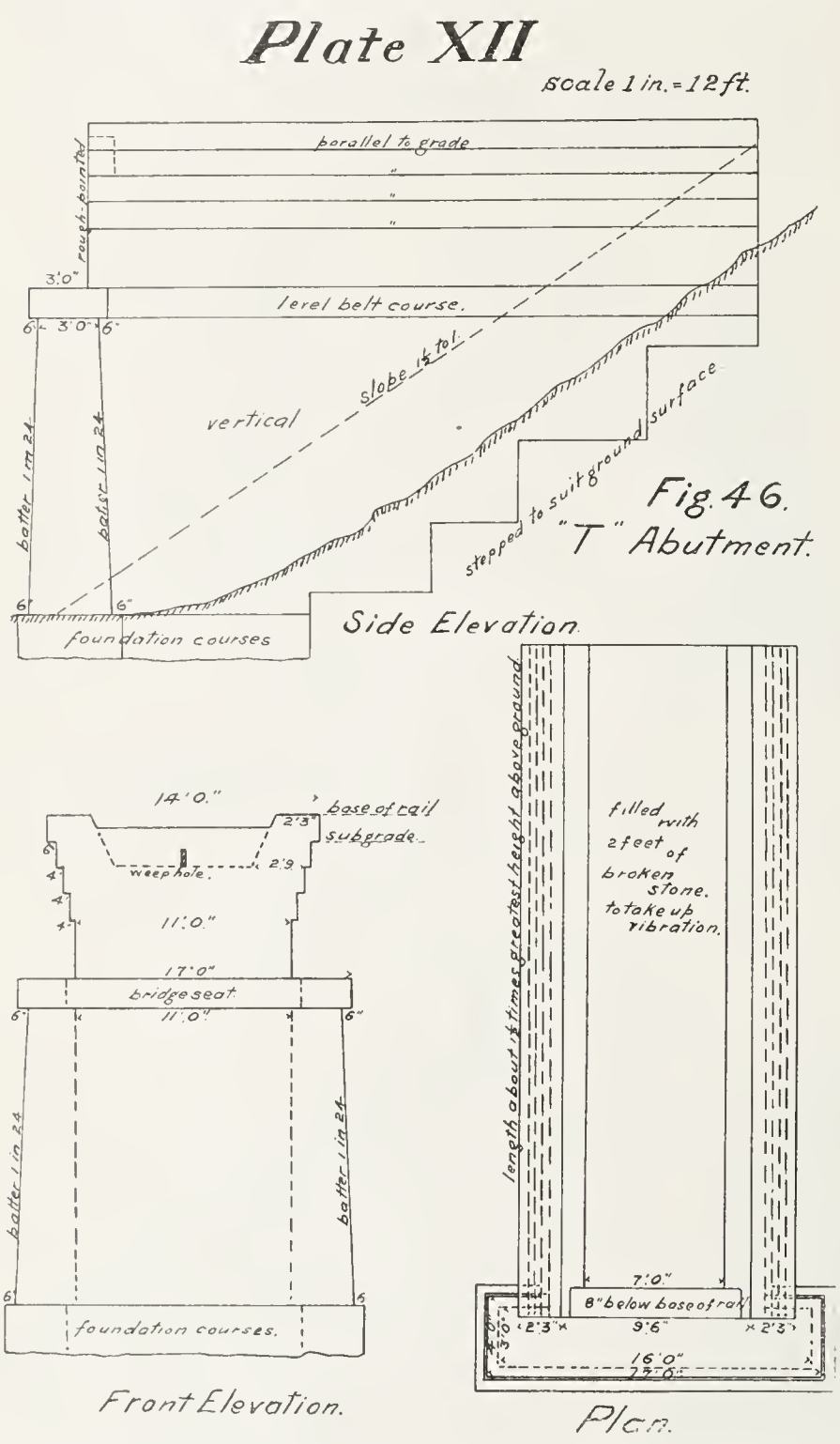



Fig. 46. "T" Abutment.

arch sheeting stones shall be of the length, depth and thickness shown on the plans, or such as the engineer shall prescribe, and shall be cut accurately on their intrados, beds and joints according to template, and shall be carefully laid with a thoroughly good bond lengthwise of the arch. The face ring stones shall be left rough on the face, except a 1½ inch intrados draft, and no projection allowed of more than 3 inches from such draft. The spandrel filling shall be rough rubble similar to good box culvert masonry, but of good bed, bond and quality of stone. The abutments and wings, or head walls and parapet walls shall be either first-class or second-class bridge masonry as the engineer may direct. (See bridge masonry specifications.

The cost of arch culvert masonry will vary with the price of stone cutting, price of brick and labor, but may be taken ordinarily at $6 per cubic yard for rubble arches; $8 to $10 for second-class arch abutments; $10 to $14 for cut arch sheeting; $8 per cubic yard for ordinary brick arches.

The quantity of masonry in arches of even the same span and rise will be so entirely dependent on the height of abutments and depth of foundations that no table will be given. The tables given for purposes of approximate estimates in Trautwine "Engineer's Pocket Book," will be found very useful.

### Article 20.—Arches.

So much has been written on this subject and the design of large arches for rivers or roadways, or for carrying roads over railways, etc., has received such elaborate study, that it is outside the range of this work, but types of such structures are given on Plate XI., and many of the remarks on arch culverts will apply to the larger structures with even greater emphasis, (*e.g.*), the importance of immovable foundations, and taking care of the line of pressures below the haunch and in the abutments, for this purpose the abutments are often built with the beds inclined to the horizontal and nearly at right angles to the pressure, see Fig. 36, and in any case should never be further from such a right angle than the angle of friction of stone on mortar.

Whether in a given case an arch or two abutments and a plate girder span will be preferable, depends on the depth of the bank and width of stream, as far as economy is concerned, but other considerations are the greater durability and safety of an arch, its finer appearance and an absence of repairs.

The use of concrete with steel rods or wire embedded in the tension side of the arch sheeting has lately come into use for arches of small rise, especially where rolling loads tend to distort the arch, the possibility of this form of construction lies in the fact that steel and concrete have almost identical co-efficients of expansion.

### Article 21.—Bridge Substructures.

As the size of waterway increases, the cost of an arch soon becomes excessive, owing to the heavy abutments necessary for arches of long span and small height. On the other hand the cost of bridge abutments increases very rapidly with the depth of bank, so that we have two limiting features to guide us in the selection of the style of structure most suitable for a given small stream or creek, *e.g.*, with a 30-foot span and embankment 30 feet high the costs about equal each other. But whenever the arch does not cost appreciably more than the open span it should be selected, owing to the absence of floor repairs and to increased safety given. It must be remembered that the addition of a solid buckleplate floor and ballast to a plate girder will, however, make it practically safe and almost eliminate repairs.

When the stream to be crossed is of considerable magnitude the question of span lengths will be the first one to decide upon, which must be done with due regard to the probable life of iron work and the cost of replacing and painting it, as well as to the total present minimum cost of structure.

The approximate minimum cost of structure is obtained when the cost of the trusses, not including the floor system, is equal to the cost of the masonry, which should include the cost of foundations, etc., but exclude the cost of those portions of abutments of which the function is to retain the earthwork and not to support the bridge, *i.e.*, the wings, etc.; but it is usually safe to arrange the spans so that the

masonry will cost slightly less than the iron, because the estimate of the latter can be made quite accurately, whereas the actual expenditure incident to river masonry construction will usually be in excess of preliminary estimates unless made with great judgment, especially in deep rivers of uncertain bottoms.

### Article 22.—Bridge Abutments.

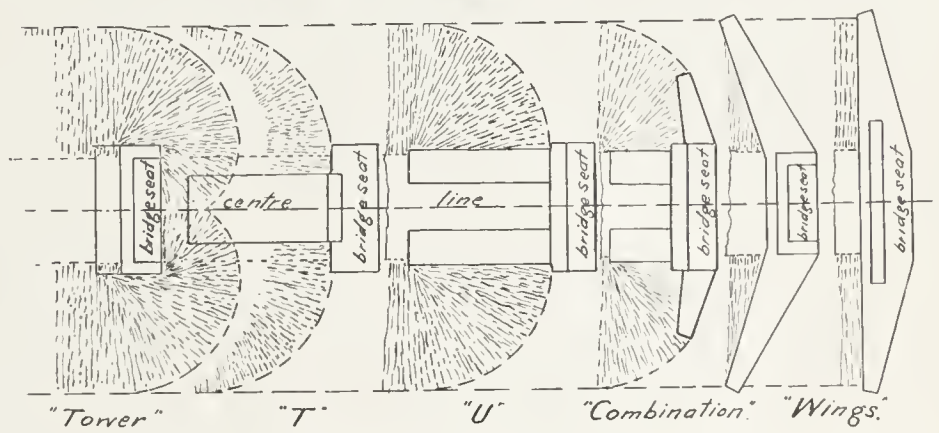
The most suitable design for an abutment will depend on the ground configuration, the position of the face of the abutment relatively to running water liable to scour, and to the amount of earth filling available—the various types in use are shown in Fig. 47. Of these, the tower abutment is always the cheapest, but can be used only when the embankment may be made all around it, on dry ground; the filling at the sides and front should be carefully made so as not to endanger its stability, practically it is used in two cases: First—Often as an abutment to an iron viaduct, with an adjacent heavy cutting and no stream to interfere with the foot of the slopes; and second, when a ravine is partly filled by a necessarily heavy cutting; but no borrow is convenient to complete the remainder, and an iron span must be used to bridge an insignificant stream.

The "T" abutment consists practically of a pier to carry the bridge span, and a masonry approach to carry the track onto the bridge. The objections to the "T" abutment are, that the masonry is damaged by vibration from the trains, and that the front cannot well be protected from river scour. The first objection is met by designing the stem of the "T" to be filled with two feet of rock ballast, to take up vibration; but the abutment must be kept well back from the bank of a stream liable to scour. The cost of a "T" abutment is less than any other (except the tower), when the conditions are favorable. These conditions are, that it is to carry a deck truss, and that the stem of the abutment is stepped into an ascending hillside, thereby lessening the quantity of masonry in it considerably. See Plate XII, Fig. 46. Essential advantages of this abutment are that it is practically in stable equilibrium from earth thrusts as the earth slopes run around the stem, and that water cannot lodge behind it. For through trusses needing wide piers, a "T" abutment is not especially economical, unless the saving on the hillside steps is considerable. The masonry for the pier should be first or second-class bridge masonry, but the interior of the stem may be of heavy rubble, with a cut facing, thus reducing the cost of the abutment to an average price of $8 to $10 per cubic yard.

The "U" abutment is similar to a "T," except that the stem is split into two parts and separated until considerable filling can be placed between the two parts. For deck spans up to 25 feet in height and through spans up to about 30 feet in height, the masonry in this abutment is less than in a "T" abutment, but above this height the quantities increase very rapidly owing to the increased lateral dimensions of the wings, which are designed as level retaining walls. The class of masonry necessary, however, is superior in the wings to that of the masonry in the stem of the "T" abutment, and the average cost of masonry will range from $1 to $2 per cubic yard more, or, say, $9 to $12 per cubic yard, so that it is very seldom less expensive to build than the "T" abutment, but it is very much used, owing to an impression that the wings are not affected by the train vibration. It must be kept well back from a scouring stream, and the toe of the slope in both of these classes of abutments should be protected by rip-rap, if there is any running water. Another serious objection to a "U" abutment is that it is liable to lodge water between the wings. This should always be provided for by weep holes. Whether this abutment is cheaper than a wing abutment will depend on the allowable slope of the earth, and also on the economy that can be effected by stepping the wings into the hillside, see Fig. 48. Some engineers economize masonry in the stems of "T" and wings of "U" abutments by introducing semi-circular arches of 10 ft. to 20 ft. span, just back of the pier-portion of the abutments

The wing abutment is usually used where the ground is level behind the abutment, and where the face is close to running water liable to scour, in which case the wings are flared back about 30° so as to prevent any contraction of the waterway. This abutment presents a neat appearance, and the backing may be made of rubble masonry, thus reducing the cost of the whole to about the price of "T"

*Plate XIII*




Bridge Abutment Types. Fig. 47

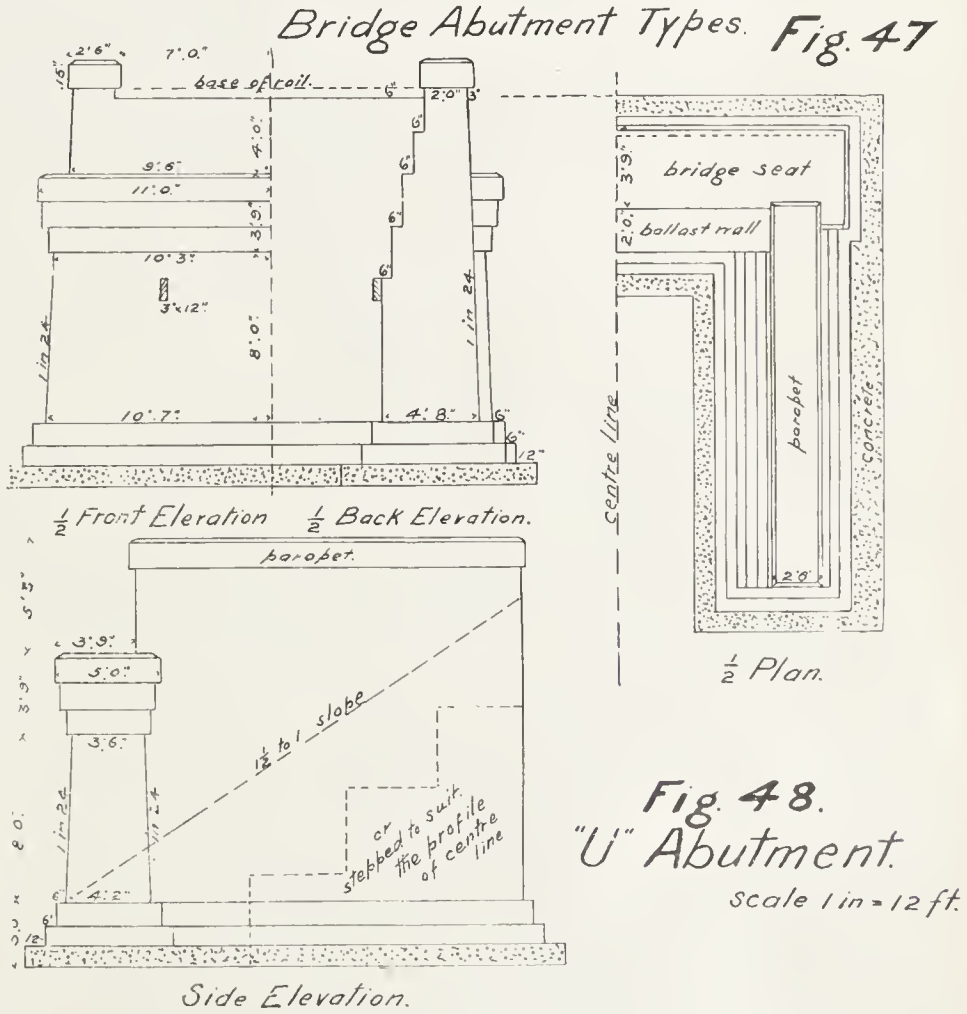



Fig. 48.
"U" Abutment.
Scale 1 in = 12 ft.

abutment masonry, *i.e.*, $8 to $10 per cubic yard, but it has several objectionable features: if the foundation below footings is deep, to good bottom, the quantity of masonry in the foundation is excessive. See table XV. (C). And also, its design as a level retaining wall is always a question of more or less doubt. The ordinary rule of the width at base, being $\frac{4}{10}$ of the height + the front batter, is satisfactory if the filling behind is of average quality, but if made of heavy wet slippery clay, the structure may be in danger. Again, in designing the foundation it is necessary to know that it will always receive support in front or else the rule of $\frac{4}{10}$ must be carried down to the foundation bed. For these reasons, an abutment with a straight back and only a tapering to the wings is preferable to one with

wings flared back, as it does not hold water behind it so readily and is not under so severe a strain tending to crack the wings from the body of the abutment. To increase the stability of a wing abutment the foundation pit in front should be always rammed solid with clay, or preferably concrete, up to the ground level, and in cold climates a frost batter given to the back of the parapet wall. See Fig. 45. This prevents the frost from dislodging it.

There is a great diversity of opinion regarding the correct cross-section of retaining walls in general, and in applying any rule or formula the utmost caution is necessary, because each design is a problem in itself; items to be considered are: the material to be used for backing, the manner of placing it, the slope of the natural ground behind and in front of the abutment, the drainage of the area behind the abutment, the kind of masonry and mortar to be used, etc. So many complexities would thus be given to any theoretical formula that in such designs it is, in most cases, best to be guided by past successes and failures in structures that have been similarly situated. The actual design of an abutment is very simple, the depth from base of rail to bridge seat, and the length of truss will be given, and also the distance apart of the trusses, centre to centre. Thus, deck trusses will need a bridge seat about 16 feet long and $3\frac{1}{2}$ to $4\frac{1}{2}$ feet wide, while through spans require bridge seats 22 to 25 feet long and 4 to 5 feet deep. The approximate quantities of masonry for different styles of abutments as given in table XV. and plotted in diagrams, will be understood as extending to a uniform foundation level, the quantity saved in "T" and "U" abutments by stepping into the hillside must be deducted, and the quantity in foundation courses added, both of which will be so much less favorable for wing abutments in any comparison involving deep foundations or steep hillsides.

TABLE XV.

APPROXIMATE QUANTITIES OF MASONRY IN ABUTMENTS.

(A.)

FOR DECK PLATE GIRDER SPANS, BRIDGE SEATS 16 FEET WIDE, CALCULATED FROM DESIGNS GIVEN IN FIGS. 44, 46, 48.

*Not including footing courses.*

| Style of abutment. | Depth from base of rail to top of footings. 10′ c. yds. | 15′ c. yds. | 20′ c. yds. | 25′ c. yds. | 30′ c. yds. | 35′ c. yds. | 40′ c. yds. |
|---|---|---|---|---|---|---|---|
| Straight wing abutment | 38 | 80 | 151 | 257 | 402 | 596 | 841 |
| "T" abutment, earth slopes, 1½ to 1 | 45 | 120 | 227 | 366 | 538 | 742 | 979 |
| "T" " " " 1 to 1 | 27 | 77 | 150 | 244 | 361 | 500 | 661 |
| "U" " " " 1½ to 1 | 43 | 101 | 210 | 358 | 582 | 858 | 1,195 |
| "U" " " " 1 to 1 | 31 | 71 | 144 | 243 | 391 | 575 | 800 |
| Tower " thickness 50 per cent. of height | 27 | 49 | 79 | 119 | 166 | 222 | 285 |

(B.)

FOR THROUGH SPANS, BRIDGE SEATS 22 FEET WIDE, CALCULATED FROM BAKER'S "MASONRY CONSTRUCTION."

*Not including footing courses.*

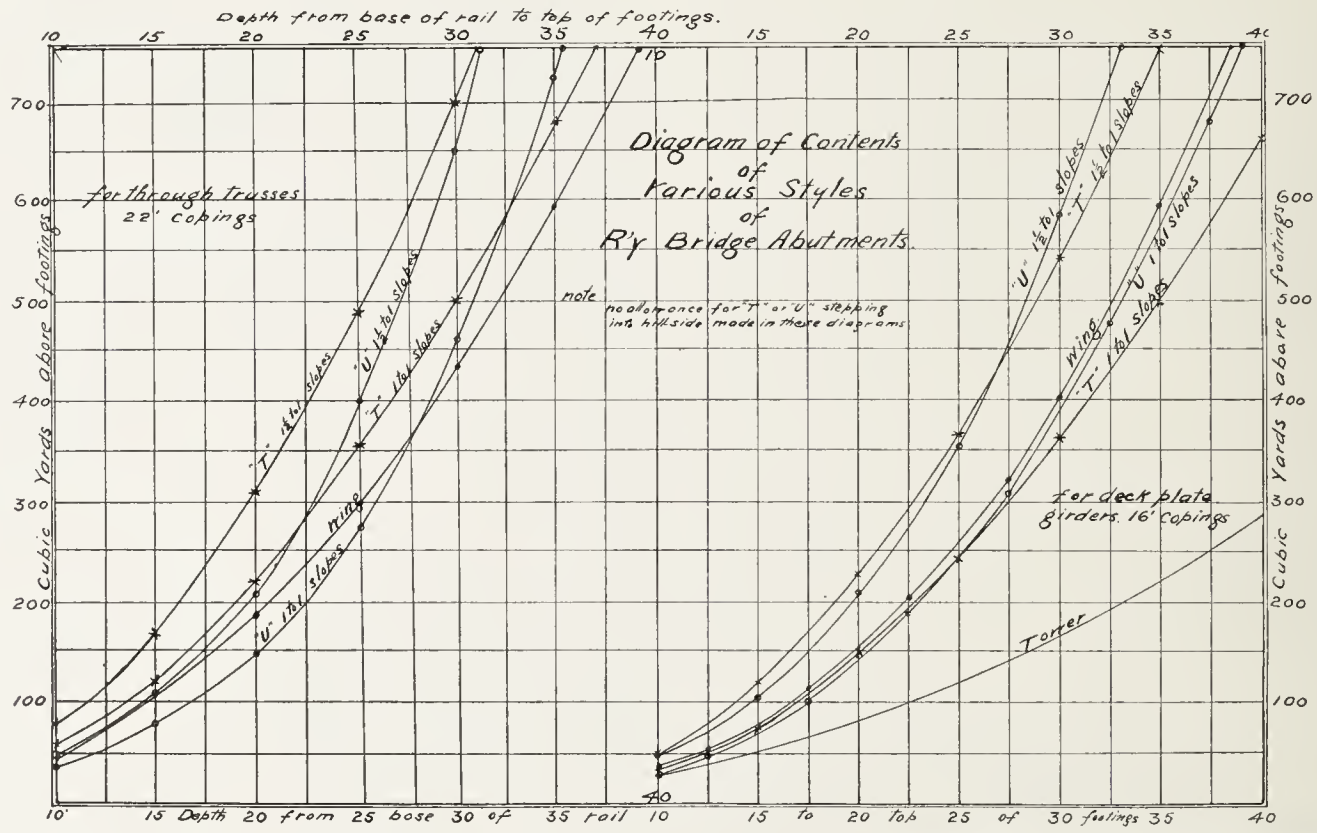
| Style of abutment. | Depth from base of rail to top of footings. 10′ c. yds. | 15′ c. yds. | 20′ c. yds. | 25′ c. yds. | 30′ c. yds. | 35′ c. yds. | 40′ c. yds. |
|---|---|---|---|---|---|---|---|
| Wing abutment | 44 | 104 | 186 | 294 | 426 | 588 | 781 |
| "T" abutment, earth slopes, 1½ to 1 | 78 | 169 | 309 | 481 | 696 | ... | ... |
| "T" " " 1 to 1 | 56 | 120 | 219 | 346 | 494 | 676 | 879 |
| "U" " " 1½ to 1 | 47 | 107 | 206 | 386 | 650 | ... | ... |
| "U" " " 1 to 1 | 36 | 80 | 149 | 271 | 452 | 712 | 1,025 |

(C.)

AREA OF FIRST FOOTING COURSE FOR FOUNDATIONS OF ABUTMENTS AS ABOVE IN SECTION (A.), ALLOWING 6" PROJECTION ALL AROUND.

| Style of abutment. | Depth from base of rail to top of footings. 10′ sq. ft. | 15′ sq. ft. | 20′ sq. ft. | 25′ sq. ft. | 30′ sq. ft. | 35′ sq. ft. | 40′ sq. ft. |
|---|---|---|---|---|---|---|---|
| Straight Wing Abutment | 265 | 384 | 569 | 797 | 1,047 | 1,330 | 1,673 |
| "T" abutment slopes 1½ to 1 | 202 | 299 | 400 | 499 | 599 | 700 | 801 |
| "T" " " 1 to 1 | 142 | 209 | 280 | 349 | 419 | 489 | 559 |
| "U" " " 1½ to 1 | 193 | 311 | 477 | 670 | 917 | 1,076 | 1,250 |
| "U" " " 1 to 1 | 129 | 213 | 323 | 458 | 614 | 724 | 806 |
| Tower " | 114 | 149 | 196 | 243 | 290 | 337 | 384 |

—Pressure on our columns has obliged us to hold over a number of interesting articles till next issue. Among them is a description of the new silver-lead mines in the Ottawa valley, and the further discussion of the Toronto city hall question.


Depth from base of rail to top of footings.
Diagram of Contents of Various Styles of R'y Bridge Abutments.
for through trusses 22' copings
note no allowance for "T" or "U" stepping into hillside made in these diagrams
"T" 1½ to 1 slopes
"U" 1½ to 1 slopes
"T" 1 to 1 slopes
"U" 1 to 1 slopes
wing
for deck plate girders. 16' copings
Tower
Cubic Yards above footings
10 15 20 25 30 35 40
100 200 300 400 500 600 700

## DISPOSAL OF TOWN'S REFUSE.

BY W. M. WATSON.

*(Continued from last issue.)*

A report just come to hand from London, Eng., on the work of one city commissioner, states that at Lett's wharf, where the dust and refuses are carted, the following articles of value were found among the garbage during the twelve months ending September 1st last, viz., cheques for £40, £23 13s., £31 16s., £42 14s. and £3; a dividend warrant for £27; a demand note for £1,000; a promissory note for £706, which were returned to the owners and reasonable rewards received, together with a good deal of money, gold rings, watches and other valuables. From the small section of London that use Lett's wharf they received besides the above, for old paper, £541 17s.; old rags, £47 10s.; bottles, £84 16s.; string, £181 3s. and books, £24. The old metals are not given in the report, so that there is more to be got out of the public refuse than many suppose.

Furnaces very similar to what is described in part can be seen working at Deseronto, Ont., only the fire boxes are not so large, because they are regularly fed by a long chute direct from the saws and carried along by a

carrier chain that feeds each boiler, keeping the fire box always full up to the top. Shoreditch, in England, compares well with many towns in Canada, inasmuch that a large quantity of the refuse that they destroy is shavings and sawdust from their staple industry of cabinet-making; that throws a large quantity of heat which is taken advantage of by that small town to supply themselves with electric light, and it is stated to be a genuine success. To add to this, they have the income from the sale of metals and other things of value sorted out of the garbage. We are told that seven towns that have visited Shoreditch by deputation are intending copying their method.

The increase during the past few years in the units of heat extracted from coal, and the fact that it is possible to convert refuse into fuel, is largely due to the improved arrangements in building flues, the design of furnaces, and adding a combustion chamber to mix and re-burn the gases and smoke that are cast off by the fires. This not only largely increases the units of heat, but also the temperature is increased, due to the introduction of combined air and steam blowers, which give a strong blast, as well as moisture, to the fire, so that the combustion of the fuel used is increased and the waste products lessened, and clinkers are prevented from adhering to the fire bars. The leading blower of this class was invented by a Canadian named Earl. It is composed of a bunch of fine steam jets that blow downward through a large taper pipe acting as an injector, bending at floor line, and passing horizontally through the brick wall into the ash pit, which has air-tight doors; behind the steam jets a pipe made from sheet iron is conveyed to above the crown of the boiler, so that when the steam jets are set in motion they draw a swift current of warm air down, which mixes with the steam, enters the ash pit, and passes up through the fire bars, coming in contact with the body of fire at the under side. The success of the refuse destructor patented by the Horsfall syndicate is due to a combined steam and air blower, similar to Earl's. Another of the kind, patented about the same period by Meldrums, has only one steam jet fixed near the end of a taper 3-inch pipe through which a strong current of air is drawn in when the steam jet is working. The combined apparatus is so small and compact that it can be easily attached to a Lancashire boiler.

I take it to be more economical to assist combustion and to increase the temperature of a furnace by blowers acting directly on the fire than it is to draw up the fire by using a long chimney, because when draughts are created by chimneys the force is at the terminating end of the heating surface, similar to a locomotive, which has its blower in the mouth of the smoke stack. By using a chimney to increase the temperature of the furnace, the hot gases are partly drawn away from the surface of the heating plates and tubes, the object of the passing heat being to get to the chimney shaft as quickly as convenient, where in most cases the hot gases arrive before they have sufficiently exhausted their heat on the heating surface of the boiler. Proof of this is established whenever a chimney is burnt out, which is often the case at the root, plainly pointing out that thousands of dollars' worth of fuel has been wasted.

While in England last year, I was shown a boiler furnace built a few yards away from where the boiler was set up on the Siemens system—the system by which steam is raised from towns' refuses, compelling the fiery gases to travel and increase their temperature before they reach the place of work. This one had proved a failure and a fuel eater, but not from any fault of the system, but from the ignorance of the designer and bricksetter. The space between the fire-box and the front of the boiler, which should have been a combustion chamber to mix and reburn the gases, was simply a large straight open space, too much for the fire to make and keep red hot, so that the gases leaving the fire made a bee line through the culvert or large flue, decreasing, in place of increasing, the temperature of the gases. The furnace should have been in two divisions, so that when one received the green coal the other would be white hot, and the gases both entering one flue, the gas coming from one with the highest temperature would take up the gases and smoke from the green coal of the other furnace and burn it, so that they both would gain the high temperature required. To enable them to do this the flue should have been somewhat smaller, so that the brickwork would be permanently as hot, if not even hotter than the fire, and have a series of fret work or bridges that would split up the gases dividing them so as to be prepared to be taken hold of by the white heated brickwork of the combustion chamber and super-heat the gases, giving them probably about double the units of heating power that they had when they left the fire bridge.

I have dwelt on this heating question because my experience in Canada is that some public works are spoiled in the minor details, or badly and ignorantly managed, which wastes a pile of public funds. For example, what a large amount of fuel and labor is wasted in the Toronto cremators that are a bill of expense and of small use, because the fumes of the foul garbage is often sent up the chimney to contaminate the atmosphere that ought to have been purified by being re-burnt in a combustion chamber when the incinerators are newly charged. To get a good practical lesson on the capabilities of refuse destructors the inquirer should visit Hamburg, Edinburgh, Shoreditch, and Bradford, where the handling of towns' refuses is performed on business principles, with the object of improving the health of the inhabitants and easing their expenses.

In this country we have many miles of land covered with sawdust and other saw-mill refuse, tannery refuse and similar combustible material that is rotting and throwing off injurious gases, creating an unhealthy atmosphere, that could be turned to profit and made to supply the nearest town or village with light and heat, or to turn the machinery for some manufactories. It is said that tannery refuse contains many units of heat, and by using a light steam and air blower it can be burnt easily, yet I saw a few weeks since three steam boilers fired with bought fuel within a few yards of a small mountain of spent tan bark that is an eyesore and a nuisance in the neighborhood. Besides all this, owners actually go to considerable expense in erecting plants to cremate the refuse from their saw-mills, which looks like wilful waste at the present time when heat and power can be transmitted many miles to places where there is a demand for it. It would almost appear that many of our people overlook these facts like the late John Stuart Mill, who made the remarkable speech in the British Parliament with the object of warning the nation against the reckless use of their coal, pointing out that the supply was limited, and that Britain's greatness partly depended on her coal. It had never crossed his mind that the sea and other waters could be made to give fuel and heat, and that the repulsive dirt and garbage swept up and collected in towns can be made to act as coal fuel, and give out as many units of heat per pound as coal was made to give in England forty years ago, and they are yet a long way behind us in England, because they blacken the air with the smoke from their boiler fires which ought to be used to assist in heating.

There is another waste in cities and towns ; where coal is used, we notice the commissioners' carts tip ashes that contain a large quantity of good fuel. Take a load of ashes, sift it with a quarter-inch riddle, place the residue in water for about a quarter of an hour, sift it again, and sort out the clinkers and other unburnable material ; then you will find that there is about half the load, clean washed carbon, that will burn as easily and give nearly as many units of heat as small pea coal. It is too bad to throw such carbon away, when many persons need more heat, and we depend upon the United States for our supply of coal.

Persons should never expect a brick setter, except he has been specially trained, to be able to build flues that will stand the heat, or turn the corners and the bends properly in a way that the heat will strike and hug the right places where it is most needed. I had a large boiler set in brick by what I thought, and was assured, was a trustworthy boiler setter ; but the apparatus would not heat, and on examination it proved that he had turned the bends of the flues in a way that the heat struck the bricks and not the boiler plates, and when the error was corrected the boiler heated thoroughly. Last year I spent a half hour looking through the mica window that showed the interior of the general combustion and heat collection chamber, surrounded in a circle with about 20 refusefurnaces, atHammerton street, Bradford, England. Each furnace had a separate combustion chamber for the reburning of its own fumes and gases ; from each of the twenty combustion chambers the gases passed into the large collecting and combustion chamber, which appeared to be about 20 yards long, 5 yards wide, and 3 yards high. The outlet of each flue leading from the small combustion chamber of each furnace entered the large one near the crown, and the gases of each could be plainly seen as they entered. There was more variety in the color of the gases than there is in the rainbow. The exact state of each fire could be known by the color of the gas the furnace was discharging. If it was a dark red it showed that the furnace was newly charged and the gases from it, even after passing the white hot brickwork of its own combustion chamber, were of too low temperature, and that the fumes coming off the burning night soil and ashes were not properly consumed, and that if such low temperature gases were allowed to pass up the chimney, they would poison the atmosphere.

Only one furnace was charged at a time, so that the other 19 were in a state of white heat, or approaching that point, so that when the low temperature gases from the new-fired furnace entered the general collecting chamber the higher temperature gases from the other 19 furnaces mixed with it, picked it up, re-burnt it, or we might say superheated it, thoroughly destroying the poisonous fumes it contained when entering the chamber before it could enter the long carrying flues to be used to raise steam by passing under and through the heating tubes of the boilers. In this second general collecting and combustion chamber lies the secret of the general success of the refuse destructor and the purity of the gases discharged from the destructor chimneys.

I have now given examples and detailed explanations to prove that the very best and most useful inventions can be made worthless and expensive by ignorance displayed in construction and management—that those towns which really desire to improve the health of the inhabitants and reduce taxation, by adopting methods invented by gifted, thinking men, may easily do so by securing the best and most experienced managers obtainable in the labor market, and do public business on the same lines as well managed private firms do theirs.

When the Hon. Joseph Chamberlain became the head of the municipal affairs of the great city of Birmingham, England, he quickly brought the public business from a state of chaos to reasonable efficiency. Such a head in Toronto might be worth at the present time about forty thousand dollars a year to the public. When Mr. Chamberlain was lately presented with the freedom of that well governed city of Glasgow, he stated in his speech that when corporations undertake such business as is now conducted by the great municipalities of England and Scotland, that their officials, the men who are entrusted with the management of departments, must be men of special capacity, special ability, or else there will be indifferent administration and great waste of public money. Canada would be quickly a great nation if it could import a dozen such men to act as controllers, and prevent public funds being spent on worthless appliances and excursion trips of men who pretend to take notes of machinery and works that they do not technically understand themselves, and often could not possibly give a valid reason for the statements made in their reports.

*(To be continued).*

## THE LIFE OF GOLD MINES.

Now that many people are beginning to look on gold mining as one of the chief industries of Canada, more interest is taken in all details of mining processes than formerly. One of the most interesting parts of the subject is that touching upon the probable life of mines, because this is a factor of the greatest consequence to the operator of the mine, as it affects his profits directly, and is also a factor in the permanent development of the country. If we are to have a rush of miners to the Klondyke, attracted by the placer diggings, we shall reap only a temporary advantage ; but if a great industry can be built up there in regular quartz mining, as Wm. Ogilvie the explorer of the country believes, and to that can be added coal and copper mining as well, the permanent character of such workings becomes of paramount interest. Extending at short intervals from Nova Scotia in the southeast to the Yukon in the far Northwest, Canada has a stretch of gold-bearing lands which are approached by those of no other country in the world. If these mines prove to be even ordinarily rich, the amount they will contribute to the wealth of the country is incalculable.

The gold mines of the Rand in South Africa are, perhaps, the scene of the most scientific mining which is being done in the world to-day, and the results of investigations made by the Rand mines are valuable aids to an estimate of possible conditions in Canadian mining, though of course the cases are, at best, remotely parallel.

The economic value of the main reef (Witwatersrand) was the subject of a paper by W. F. Wilkinson, read before the Chemical and Metallurgical Society of South Africa recently. The author discussed, among a number of subjects, that of the life of the mines in the main reef of the Rand, 27½ miles in length. The data which he assumes are very interesting, as showing, among other things, the best scale upon which mining operations in South Africa are conducted. The assumptions are: Depth of mining, 5,000 feet vertical ; length of reef on dip, 10,000 feet, on a basis of the Bezuidenville and Rand Victoria's borehole sections ; one ton—12 cubic feet ; average thickness of reef milled, allowing for waste, 4 feet.

| | |
|---|---|
| Approximate outcrop distance in feet is | 145,750 |
| Million tons to 5,000 feet vertical | 486 |
| Estimated value per ton, in shillings (yield) | 36.8 |
| Gross value in million pounds sterling | 892 |
| Profits with working costs at 25s. per ton in millions of pounds | 286 |
| Profits with working costs at 20s. per ton in millions of pounds | 406 |

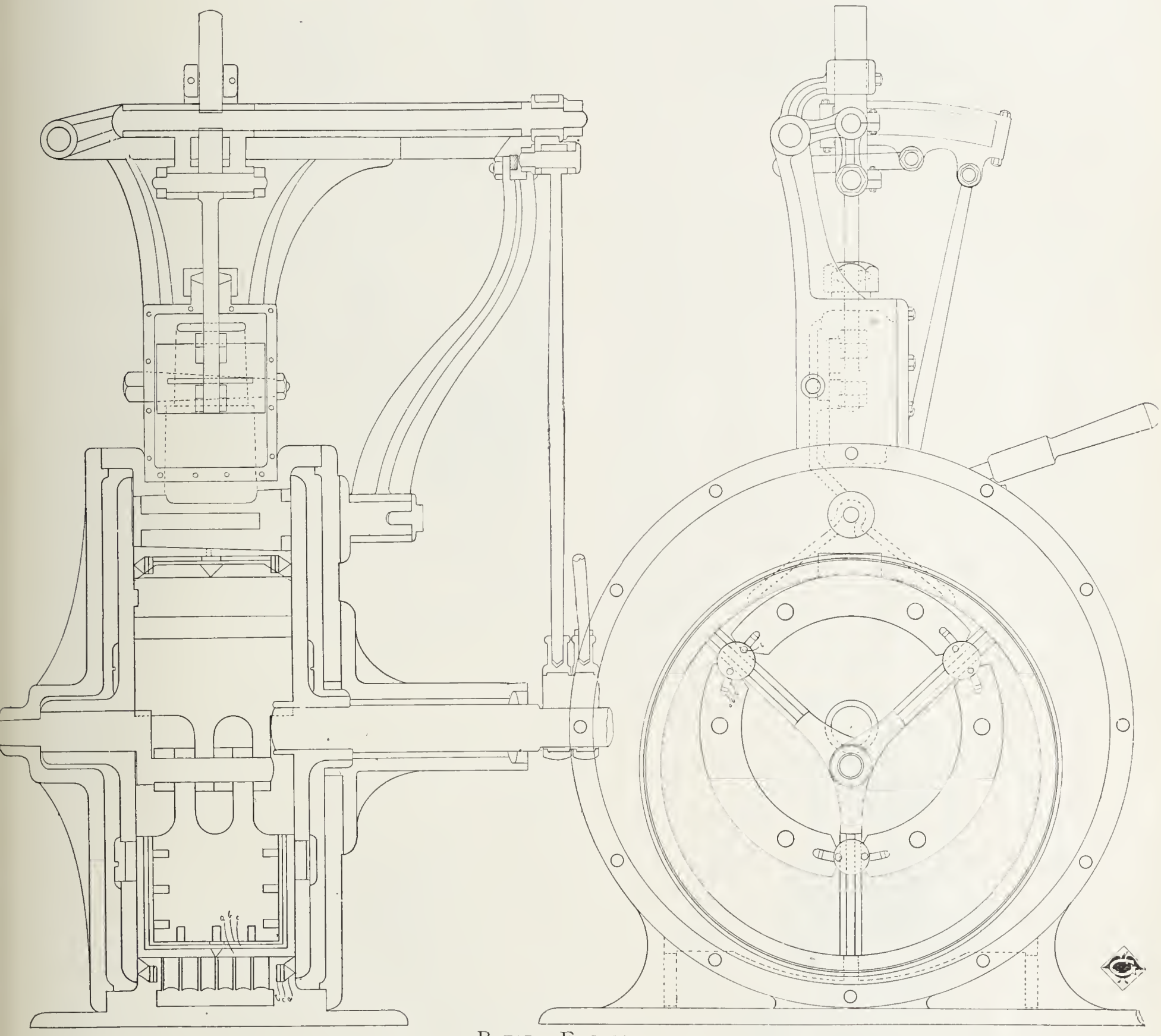
The result of this estimate shows that for this part of the Witwatersrand alone a tonnage of 486 (mills) having gold contents of £892,000,000, is available for mining. From these figures the amounts already won must be deducted. It may be useful for reference if similar estimates are given, which have been made from time to time :—

| | Year. | Greatest vertical depth. Feet. | Million pounds. | Miles of outcrop. |
|---|---|---|---|---|
| Hamilton Smith | 1893 | 3,000-3,500 | 325 | 11½ |
| Schmeisser | 1893 | 3,900 | 350 | 11½ |
| Hatch and Hammond | 1895 | 5,000 | 592 | 27 |
| Becker | 1896 | 5,000 | 700 | 20 |
| Hays Hammond | 1895 | 5,000 | 9 per 1 mile outcrop 1,000 feet depth. | |

At the present time (1897) the tonnage milled from the Witwatersrand and district is between four and five million tons a year. Making allowance for the deep-level mines, and assuming that double this amount is removed, we get a life of, roughly, half a century. "This I consider," Mr. Williams concluded, "the very least period that the Rand mining industry will be of first-rate importance."

## ROTARY ENGINE OF CANADIAN DESIGN.

The origin of the steam engine is now known to belong to a period before history began to record anything but mere political events. Hero of Alexandria produced a manuscript, 120 B.C., in which he describes a number of primitive forms of water and heat engines, and among the latter, that shown in the illustration on next page. This consisted of a globe held between trunnions, the steam entering from the boiler below through one of these. The



Rotary Engine.

rotary motion is produced by the reaction of the steam, which escapes from the bent arms. It is supposed by some that this contrivance was actually used by the Greek priests to produce motion in other apparatus. The next rotary engine is probably the model constructed by Denys Papin, in 1690, for working pumps and driving paddle wheels. This consisted of a cylinder and a piston, which was raised by steam pressure, its descent being permitted by the vacuum produced by the condensation of the steam.

Every engineer is aware of the loss of power insep-

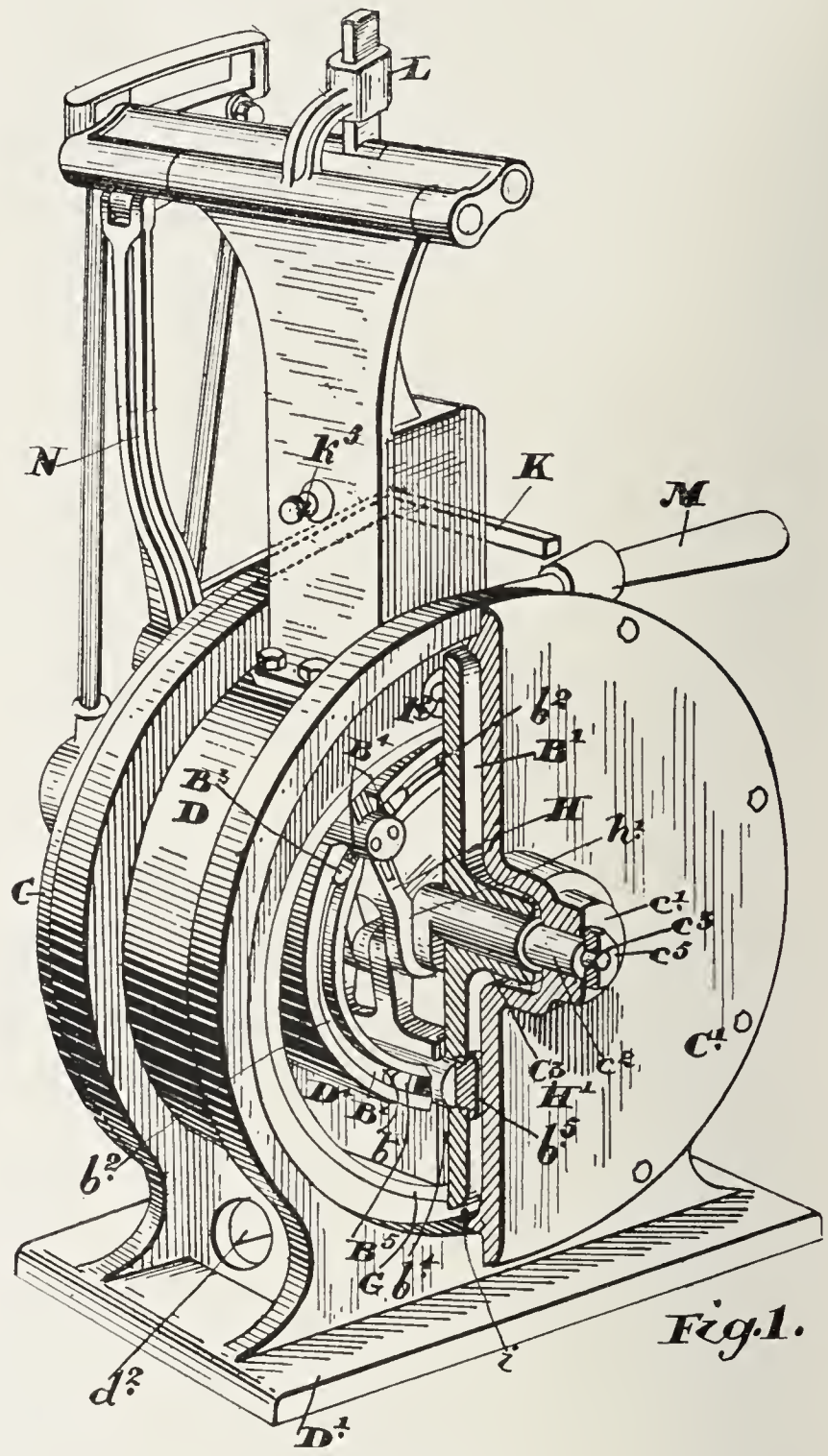
arable from the movements of all types of engines now in common use, and most engineers are familiar with the almost innumerable attempts made to get the rotary principle into practical use. So far the enormous consumption of steam has been the point at which all inventors have stuck, and most inventors of rotary engines have encountered further difficulties in designing an engine with parts that will not grind, and yet are steam tight.

In advance of a scientific test we are not prepared to say that the type of engine we are about to describe surmounts all these difficulties, but a representative of THE CANADIAN ENGINEER visited the works of Messrs. Baird & Tree, at Woodstock recently, and saw a rotary engine that had been in daily use over six months, and when taken apart the internal parts that would be most subject to wear still show the marks of the hand scrapers. This would seem to settle the question of steam-tight chests with absence of grinding. As to the consumption of steam, the inventors and designers of this engine have an ordinary old upright boiler, such as is used on threshing machines, and their consumption of fuel is one and a half cords per week of beech and maple cordwood, running $13\frac{1}{2}$ hours per day. The engine operated by this boiler has a cylinder of 4 inches face and $8\frac{1}{4}$ inches inside diameter, the ring piston taking up $6\frac{1}{4}$ inches of that. Out of this they estimate that they get eighteen horse-power with steam pressure of one hundred pounds, engine running at nine hundred revolutions per minute. They at first used a four-inch rubber belt, but had to change it for a six inch belt and have been operating the following machinery running from two lines of shafts, besides counter shafting: one engine lathe of four feet swing over shears and eighteen feet bed, one engine lathe of twenty-two inch swing and ten feet bed, one engine lathe sixteen inch swing and eight feet bed, one shaper sixteen by twenty-eight inches, one drill press thirty inches, one drill press twenty inches, one set emery wheels; these, we understand, have been all in operation at one time on fifty pounds steam, running at 400 revolutions. This engine is mounted on a light wooden box, and has been run at between 1,400 and 1,500 revolutions per minute with little

HERO'S ROTARY ENGINE.

vibration. Our readers will, no doubt, be interested in the forthcoming test of the large new engine of this time, which will take place, we understand, at McGill University, Montreal. Messrs. Tree, Baird and Eldon, the inventors, designers and promoters are all young Canadians.

Fig. 1 shows the external appearance of the engine, with one-half of each of the two circular casings on one side removed, so as to exhibit the inner mechanism. *D* is a hollow cylinder attached to a bed plate $D^1$; the hollow of the cylinder is not placed centrally in *D*, being dropped down a little, and thus the main shaft does *not* enter at the centre of this hollow. *D* is cored out so as to




ROTARY ENGINE.

leave a flange on each end or side, and to these flanges are bolted two circular casings *C* and $C^1$, which enclose the two open ends of the cylinder *D*. Into the cylinder *D* is placed the ring piston $B^1$ (see Fig. 2 and outline), which is a smaller hollow cylinder placed eccentric to the larger one, and in contact with it at the top, thus leaving a crescent-shaped chamber $D^4$, in which the steam acts. The ends of the ring piston are enclosed by circular casings or discs *B* and $B^2$ (see Fig. 3), which extend beyond its periphery so as to have a bearing on the larger cylinder *D* just inside of the outer casings *C* and $C^1$, and thus enclose the crescent-shaped chamber which is made perfectly steam tight by means of automatic adjustable packing. The casings *C* and $C^1$ of course are stationary, but casings *B* and $B^2$ revolve with the ring piston on the main shaft, to which they are attached solidly; the ring piston and casing *B* are one piece, the casing $B^2$ being bolted to the ring piston, and all three are solidly attached to the main shaft *A* (Fig. 3). The main shaft is propelled by means of three wings *H*, *H*, *H* (see Fig. 2) which act on the ring piston.

Figs. 2 and 3 are vertical sections of the engine, the one at right angles to the main shaft and the other parallel to it. They show the relation of the ring piston, the wings, the shafts, etc. In the ring piston $B^1$ are three slots equi

distant from each other, and in each slot is placed a bronze swivel $H^1$ (see Fig. 4) with an opening $h$ through which

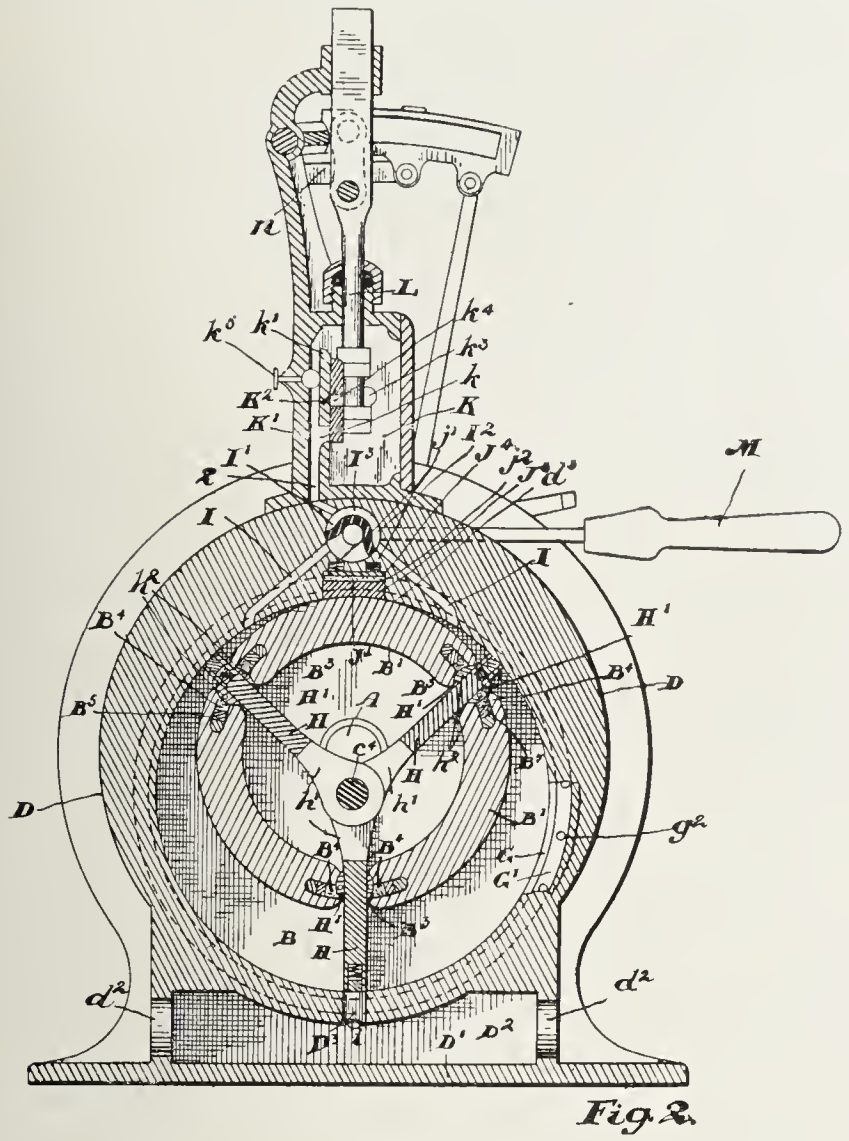


Fig. 2.

the wings slide. Now it will be seen that the main shaft $A$ (see Fig. 3 and outline also) passes through the outer casing $C$, is solidly attached to the inner casing $B$, and acts at the centre of the ring piston, projecting into it a very short distance only; also that the outer casing $C$ provides a journal for the shaft. The shaft on which the wings $H$, $H$, $H$ rotate is stationary; it is solidly attached to the outer casing $C^1$ at $c^2$ on the side opposite to the main shaft; it then becomes a shaft on which the revolving casing $B^2$ is journalled at $C^3$; on entering the ring piston hollow it has an offset $C^4$ and becomes the wing shaft at $c^4$, acting at the centre of the hollow of the cylinder $D$, through which the wings sweep.

Fig. 4 shows a section of the ring piston, a slot, a swivel $H^1$, an opening $h$ for the wings, and the automatic adjustable packing.

Fig. 2 and the outline, or working drawing, also show

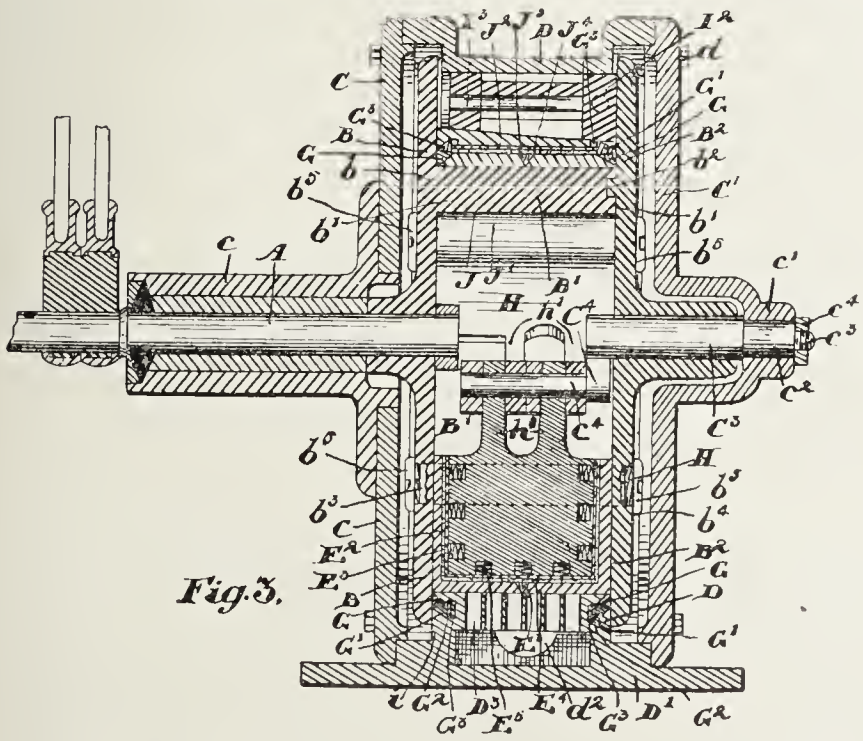


Fig. 3.

the course and the action of the steam. The steam chest $K$ is set in between the flanges of $D$. The slide valve is worked by means of a link motion connected with the main shaft by an eccentric shaft (see also Fig. 1). By a novel device the lever $M$, for reversing the engine, connects with the link motion, and at one stroke reverses the engine. The live steam passes from the steam chest to the reversing plug and onward through a short channel $I$, entering the crescent-shaped chamber at the port. Notice again that the ring piston is attached to the main shaft, and that the wings rotate on a stationary shaft attached to the side opposite to the main

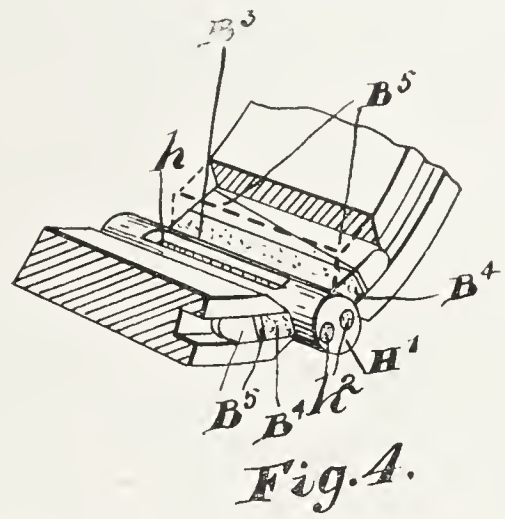


Fig. 4.

shaft, and thus the action of the wings in propelling the ring piston. Now the live steam, entering the port at the narrow part of the crescent, acts on a wing until cut off by the valve, and then expansion acts in the larger part of the crescent until the wing reaches the exhaust port at $D^3$. As soon as exhaust commences, live steam begins to act on the next wing, the power of the live steam increasing as that of expansion decreases, which gives a constant and a continuous pressure. The slide valve is so arranged that steam may be cut off at any stage, and thus allow live steam to be economized and expansion to be utilized to almost any extent; one up and down stroke of the valve allows steam to act on the three wings in succession. Not only does live steam act in the small part of the chamber and expansion in the large part, and both in treble succession, but as the expanding steam grows weaker its leverage on the wing becomes greater as the wing moves to the port $D^3$, and thus a further use of expansion. Again, instead of a back pressure at the time of exhaust, there is a forward pressure, for when

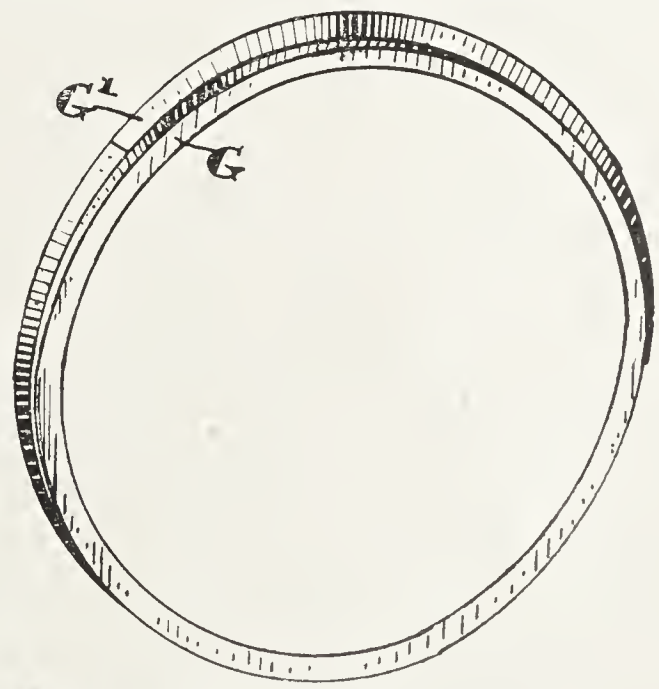


Fig. 5.

the wing passes the exhaust port at $D^3$, there is a pressure against the wing receding from $D^3$ as also against the one advancing to this port; but the steam surface of the receding wing is greater than that of the advancing wing, and thus a resultant forward pressure. The port opposite to the one used as an intake is used as a supplementary exhaust for any trifle of steam that may not exhaust at $D^3$.

Friction in this engine is reduced to a minimum, and perfect steam tightness is secured by means of its revolving casings and novel system of packing. The crescent-shaped chamber is enclosed by the revolving casings $B$ and $B^2$; these casings do not bear on the face of the cylinder $D$, although so close that they almost touch it; Fig. 5 shows a couple of $V$-shaped packing rings which are placed in a groove $G^1$ (Fig. 2) and which with springs $g^2$ act automatically in producing steam tightness between the revolving casings and the face of $D$, and also in reducing friction to the minimum quantity. Again, where the ring piston is in contact with the cylinder $D$, an automatic adjustable packing block $j^3$ (Fig 2) is used. Also, it will be clear that the wings in making a revolution do not rub against the sides of the casings $B$ and $B^2$, as these casings likewise revolve, wings merely slipping in and out against them a short distance; the wings, however, do not touch any portion of the cylinder $D$ in revolving, as they are packed on their sides and ends with two $L$-shaped pieces and a $V$-shaped block, adjusted by springs, which again secure perfect steam tightness with a minimum of friction.

## ACETYLENE FROM THE UNDERWRITERS' STANDPOINT.

Since calcium carbide has become an article of commerce, and acetylene gas is being employed as an illuminant, especially in country places and small towns where fire protection is inadequate, the conditions under which the carbide may be safely manufactured, handled, and stored, and the resulting acetylene gas produced and employed, has become a matter of the greatest importance to the companies engaged in the business of fire insurance. The underwriters of Ontario have published a set of rules for the use of calcium carbide and acetylene gas which are much more severe than those laid down by the underwriters of Manitoba. The London Ins. Co., London, Ont., the Perth Ins. Co., Stratford, Ont., Wellington of Guelph, and the Millers' and Manufacturers' Ins. Co., Toronto, have secured a special report on calcium carbide and acetylene gas from Prof. E. B. Shuttleworth, F.C.S., whose wide experience and recognized ability as a chemist and analyst give his conclusions much weight. We append Prof. Shuttleworth's report:—

In comformity with your instructions I herewith submit the result of a study of acetylene with especial reference to the risks involved in its manufacture and use. When viewed from this standpoint the subject presents certain subdivisions, each of which demands separate consideration, so that the conclusions formed may be directly available for insurance purposes. Before entering upon a discussion of these questions I would explain that as the literature of the subject is, so far, almost exclusively confined to papers and articles which have appeared in technical and scientific periodicals during the past two years, I shall take the opportunity of recording those facts which are likely to prove of interest or value to the underwriter. I propose to present the subject under the following general headings:—Manufacture, storage and carriage of calcium carbide; manufacture of acetylene at low pressures; use of low pressure acetylene for illuminating purposes; use of compresses or liquefied acetylene for illuminating purposes.

### MANUFACTURE OF CALCIUM CARBIDE.

The preparation of carbide as carried on under the Willson process, patented in 1894, consists in submitting a mixture of powdered lime and charcoal, or coke, to the heat of a powerful electrical furnace, in which the temperature probably reaches 10,000° F. The lime, which chemically speaking, is oxide of calcium, is decomposed, the oxygen being replaced by carbon. In the ordinary working scale it requires about six hours to effect the change. The result being a pig of fused carbide weighing about 500 pounds. The mass is removed by a hydraulic crane and allowed to cool. This requires about two days, when the carbide is broken up, by sledges, into pieces which will pass through a 5-inch opening, and is packed in strong tins furnished with a screw-cap and generally holding 100 pounds. These tins are afterwards encased, in pairs, in a strong wooden box. This is the plan pursued at the Willson Carbide Works, on the Welland Canal, at Merritton, from which the Canadian supply of carbide is, in great part, derived. On October 29th, by invitation of the inventor, I had the privilege of thoroughly inspecting the entire works and witnessing all phases of the manufacture. These works commenced operations in August, 1896, and are now turning out about sixteen pigs, or about four tons, per day. A second factory is almost completed, at a lock lower down the canal, and a third is being built still further below. The energy at command in these establishments will equal over 1,500 horse-power. The factories cost about $30,000 each.

The carbide produced is in exceedingly hard pieces, of a grayish-black color; semi-crystalline in structure; about two and a half times heavier than water (sp. gr. 2.26). Commercial carbide is never pure, that of good quality containing 80 to 90 per cent. of the true compound. It is liable to contain calcium phosphide, an impurity which, in the production of acetylene, may give rise to spontaneously inflammable gas, and thus cause accident. This will be afterwards alluded to. Analyses of European carbide have sometimes shown as much as 3 per cent. of phosphide, derived from impure lime, or coke. It is claimed that the Canadian product is made from lime which contains only 0.96 of impurity, other than magnesia, and that, as far as known, it is free from phosphide. This would have to be determined by actual analysis. Carbide is not inflammable, does not explode by friction or shock, as abundantly evidenced by the rough handling it receives in breaking. It is not affected by dry steam, but when exposed to the air, quickly combines with the watery vapor present, and gradually evolves the gas, acetylene. This is formed by union with the hydrogen of the water, the oxygen and part of the hydrogen combining with the calcium, thus producing slaked lime. In other words, carbide of calcium, plus water, yields hydrate of calcium, plus acetylene. In the presence of moist air this change goes on very slowly, as the coating of lime formed on the lumps of carbide acts as a protective. The gas generated passes off into the air, and under practical conditions, as in carbide works, is not at all likely to do harm, It has been asserted that when a quantity of powdered carbide is brought into contact with a relatively small amount of water, the heat produced is sufficient to ignite the liberated acetylene, but I have not been able to bring about this result at ordinary air pressures. The heat liberated is, no doubt, carried off by the watery vapor generated, and the temperature does not, therefore, rise above boiling.

In the Merritton, Ont., works there were in the same room four electrical furnaces, in active operation, with their attendant heat and flame; on the floor were at least twenty pigs of carbide, some of them white hot, and several resting in shallow pools of water formed from leaks in the hydraulic hoist apparatus. I was informed that from August, 1896, until Jan., 1897, the pigs of carbide were not cooled by exposure to air, as at present, but by playing on them with a hose. The risks of percussion

were fully represented by the sledge-hammer blows constantly falling on the lumps of carbide, and I saw no evidence of the production of flame in this way, as stated by one author. None of the window openings were fitted with sashes, and in rainy weather, accompanied with wind, much water would, undoubtedly, blow on to the carbide distributed over the floor. Radiated heat, heat of percussion, flame, and water, existed concurrently in this apartment, but no injury resulted, and I was assured by Mr. Willson that none had been realized, or was anticipated.

I believe that buildings for the manufacture of carbide should for insurance purposes, occupy a position combining the conditions present in foundries, and places where electrical energy is developed. They should be built with fireproof walls, preferably of corrugated iron ; be well ventilated and lofty, so as to provide for the quick and complete dilution, and rapid escape of any evolved gases.

### STORAGE OF CARBIDE.

Much of what has been just stated is applicable to the question of the storage of carbide. In the absence of water the compound is no more dangerous than is so much limestone. With water there is the formation of acetylene gas, but, except pressure is thus generated—a condition which, under such circumstances, is difficult of fulfillment—there is practically no liability to accident in the absence of flame. Water and fire together constitute the element of danger, while in the case of gunpowder and other explosives, and with inflammable liquids, as alcohol, gasoline, turpentine, etc., the latter is alone sufficient. The difference in risk is in some degree proportional to the probability of a co existence of the disturbing conditions. At the time that the fire took place at the Polson Works, at the foot of Sherbourne street, Toronto, there were standing in the building two tins containing carbide. The heat was sufficient to melt the solder of the tins, but the carbide was quite unaffected It is not likely that this would have been the case with gunpowder, varnish, coal oil, or any of the liquids mentioned. In the furnace room of the Willson Carbide Works, already described, there was stored, at the time of my visit, some 80 tons of carbide, packed in tins and cases, and piled about ten tiers high. This was stated to be a small stock, and supplies of carbide had been stored here for more than a year, without accident, though fire and water were always in close proximity.

I am of opinion, with proper provision for keeping the carbide in substantial, properly sealed, water-tight, metallic cases, enclosed in wood in order to protect the tins from external violence, and the storing of such packages in a well-ventilated apartment, the risk would not at most be greater than with ordinary inflammable liquids.

### CARRIAGE OF CARBIDE.

This question may for the most part be decided by the arguments already brought forward, but there is introduced a new element of danger in the transmission of the carbide by water, where there is a possibility of partial or complete submergence in that element, and where packages might be stored in the unventilated, damp holds of vessels. From imperfect sealing there might be slow evolution, with consequent accumulation of gas, which, by admixture with air and subsequent contact with flame, might produce explosion. In order to test whether the ordinary commercial package was impervious to water an experiment was made at the Merritton Works, of which the details were communicated to me. Two 100 lb. tins were suspended for several days in the tail-race, where they were completely immersed and subjected to some motion. At the close of the trial one of the tins had suffered a loss of six pounds of the carbide, and the other was intact.

I desired to ascertain whether the sudden inrush of water, and the subsequent application of flame, would give rise to explosion of an ordinary commercial package. I therefore made an experiment, which, from the quantity of carbide operated upon, might be considered of an ultra-crucial character. A full 100-lb. package was selected at random from a large number. The tin was 12 inches square by 18 inches in height, and was made of IXX sheet steel of 27 gauge, with an opening of five inches closed by a screw-cap. The cover was removed, a gallon of water instantly dashed in, and a light applied. The result could not in any sense be called an explosion. There was a sudden ignition of the evolved gas, which continued to burn quietly to the height of about 18 inches for 10 or 15 minutes, when more water was thrown in, producing a slight increase of flame. The gas continued to burn for about half an hour. The heat produced was only sufficient to melt the solder off the screw collar at the top of the tin. There was some diminution in the bulk of the carbide, but the larger pieces remained intact, and when the crust of lime was brushed off, were otherwise unchanged. The experiment clearly demonstrated that, under the trying conditions described, the ignition of the gas from the admixture of relatively large quantities of carbide and water would not give rise to an explosion, while the combustion was not more uncontrollable than would have been the case with many inflammable liquids.

I think that the carriage of carbide in the close holds of vessels should be subject to restrictions, and is attended with some risk.

### MANUFACTURE AND USE OF ACETYLENE AT LOW PRESSURES.

The manufacture and use of acetylene at low pressures, slightly over that of the air, and not exceeding say $1\frac{1}{2}$ ozs. to the square inch, must be considered separately from that of more strongly compressed or liquefied gas. The latter are of a much more unstable and dangerous character, and their behavior towards disturbing agencies is, so far, imperfectly understood. Acetylene, as before stated, is produced by bringing calcium carbide in contact with water. One pound of carbide should yield, theoretically, over $5\frac{1}{2}$ cubic feet of gas, but owing to the impurity and deterioration of the carbide, only about five feet are produced, manufacturers usually guaranteeing 4.66 feet. The reaction is very vigorous, gas being liberated with great rapidity, and with the formation of much heat.

The gas is of specific gravity, 0.91, and is, therefore, nearly one-tenth lighter than air and about twice as heavy as coal gas. It possesses a peculiar and disagreeable odor—a character which serves as a useful warning of its presence, and the consequent detection of leaks. At air temperatures it can be liquefied by a pressure of about 600 pounds to the square inch, and by extreme cold can be solidified. Acetylene is stated to be more inflammable than any other gas, not even excepting hydrogen. The point of ignition is about 900°, that of coal gas being near 1,400°. The flame produced is exceedingly luminous, being variously estimated at 10 to 20 greater than that emitted in the combustion of an equal volume of ordinary gas. The products formed are mainly carbonic acid and water, with little if any combustible gas containing carbon. These products, as also the heat generated from flames of equal luminosity, are much less with acetylene than coal gas, or carburetted water gas. · When acetylene

is mixed with air in the proportion of three per cent. of the former, the mixture begins to be slightly explosive; at little over eight per cent. the maximum explosive effect is reached, and when the acetylene reaches eighty-five per cent. explosiveness ceases. With coal gas the limits of explosion are between five and twenty-eight per cent, and with water gas from nine to fifty-five per cent. The maximum explosive effect with acetylene is reached when the proportion is 1 to 12 of air; with coal gas, 1 to 6; and water gas, 1 to 1. It is thus evident that acetylene begins to be explosive with a less admixture of air than either water or coal gas, and that it retains its explosiveness through a greater range.

If acetylene, at a pressure of over two atmospheres, is heated to 1,437° F., it is dissociated or resolved into its constituent elements, carbon and hydrogen, the former being deposited. Dissociation is accompanied by the sudden liberation of much heat, with a corresponding rise of pressure, and consequent explosive effect. While acetylene, without admixture of air, is strongly explosive, it must be remembered that in the experiments by which this was established, the gas was always under pressure, and in most cases was heated by the container being placed directly over a flame of fire. It has not been shown that at air pressure the gas can be exploded by heat, shock, detonation, the electric spark or by a white-hot platinum wire. Though decomposition may be thus set up it is confined to the point of disturbance, and is not propagated to the mass of the gas. It is asserted that this result will not follow so long as the gas is under pressure of less than two atmospheres. If acetylene at low pressures be confined in a receiver from which a pipe passes, the end of which is closed; and at a distance of five feet from the receiver the pipe be heated to 1,437° F., sudden decomposition, accompanied by sudden pressure, will take place. If acetylene be passed through a hot porcelain tube its constituents are polymerized, or rearranged, so that the product is no longer acetylene, but may appear as naphthalene, or other solid or semi-solid hydrocarbon. This is the result of heat on uncompressed gas, and indicates a danger in the blocking up of pipes and burners traversed by heated acetylene.

The impurities of acetylene are due to foreign matter in the carbide, and as far as relates to the subject of this investigation, are phosphuretted hydrogen, siliciuretted hydrogen, and ammonia. The two former are spontaneously inflammable, and are thus a source of danger, while the latter may attack copper or brass portions of the apparatus, which, by subsequent contact with moist gas may form explosive compounds. These compounds consist mainly of cuprous acetylide, and do not appear to be formed except the copper or alloy is oxidized, or perhaps only when an ammoniacal compound is generated. Pure, dry acetylene does not combine with copper. The copper salts are very sensitive to shock, friction, or heat, and when exploded may serve as detonators, though, as previously stated, the explosion in uncompressed gas would be merely local, but under 30 lbs. to the inch the impulse would be transmitted to the mass of acetylene.

The above facts thus briefly summarized, point out certain dangers to which the manufacture and use of low pressure acetylene is liable. They may be enumerated as follows, an attempt having been made at arrangement in sequence of importance :—

1. Formation of explosive mixtures of acetylene and air, as produced by defects in generating apparatus, or escape of gas through fixtures. 2. Production of heat and pressure by the too rapid decomposition of the carbide. 3. Secondary formation of gas by watery vapor, or the dehydration of slaked lime by the carbide, after the conclusion of the ordinary process. 4. Generation of dangerous pressures in apparatus insufficiently provided with relief attachments. 5. Formation of explosive compounds with copper or its alloys. 6. Production of spontaneously inflammable gases originating in impurities in the carbide. 7. Blocking of pipes by solid hydrocarbons resulting from polymerization of acetylene. 8. Evolution of gas from imperfectly exhausted carbide residues.

Before discussing these points, it may be said that the apparatus for generating acetylene consists primarily in an appliance for producing the gas, and a receiver for holding it for distribution. Generators are of two kinds. In one the carbide is brought in contact with a relatively small quantity of water, projected automatically; in the other, the carbide is put into a relatively large quantity of water.

(1). Acetylene, as has been shown, forms an explosive mixture with air, as do other illuminating gases. The question is merely that of degree, and this is indicated by the figures given, but it must also be remembered that the acetylene mixture is more powerfully explosive than are those of the other gases. In forming a general conclusion, the fact of the different diffusibilities of the gases must also be taken into account. Coal gas, on account of its lower specific gravity, would issue much more rapidly from a leak than would acetylene, but against this must be set the fact that the latter, being much heavier than coal gas, would be more liable to accumulate in badly ventilated spaces. In the case of escape of gas from an unlit, open burner, the quantity of acetylene would be much less than that of coal gas, not only for the reason stated, but on account of the diminished capacity of acetylene burners, which only allow about one cubic-foot to pass per hour, while those for coal gas are usually arranged for five times this volume. When these facts are balanced against one another the danger of accident from explosive mixtures with air does not appear to be appreciably greater with acetylene than with coal gas.

(2) That explosion, by dissociation, is possible from a too rapid decomposition of carbide seems to have been domonstrated by good authorities in Europe. I have repeated some of the experiments made, in one case operating on ten pounds of carbide, but, perhaps fortunately, without confirming the results obtained by others. The fact that carbide will not combine with dry steam at a high temperature is against the theory of explosion, which necessitates the presumption of a temperature of 1,437° F., as determined by Gerdes, of Pintsche's laboratory. If a lump of carbide be heated on an open fire and sprinkled with water, inflammable gas is not produced. In view, however, of our somewhat uncertain knowledge of commercial carbide, under such circumstances, it is necessary to make provision against possible accidents, and this is, no doubt, one of the objects sought by generator manufacturers. With properly constructed apparatus the danger of accident might be entirely obviated.

(3) The secondary production of gas, after the first effect of the addition of water to carbide has taken place, may always be observed. The heat of the reaction generates steam, which mixes with the gas in the generator, and afterwards condenses on the carbide, thus giving rise to a second, but relatively feebler evolution of gas. The affinity of carbide for water is also so great that it will dehydrate the slaked lime, with which each lump of carbide is coated, thus bringing about slow production of gas. While consumption from the receiver is going on there is

not much likelihood of the accumulation of pressure, but if the gas is not being used such result would follow, but could be provided for by a relief valve, or water seal, opening outside the premises. The danger, like the former, is dependent on the construction of the apparatus.

(4) Dangerous pressures, from any cause, can be similarly met.

(5) With regard to the presence of explosive copper compounds, it has been shown that such are dangerous in acetylene at high pressures. But authorities agree that at air pressure, and when not exceeding two atmospheres, the effect of such disturbing agents is that of only bringing about local detonation, which is not transmitted to the body of the gas. It has been proved that the presence of ammonia is the prime cause of the formation of these copper salts, and provision might be made against danger by the avoidance of copper or brass in the construction of apparatus.

(6) Several explosions of compressed acetylene are reported as having possibly originated in phosphuretted or siliciuretted hydrogen generated from impure carbide. It is likely that such might be dangerous constituents of low pressure gas. In view of this some provision for the inspection or analysis of carbide should be put in force. This might take the form of a guarantee of purity furnished by manufacturers.

(7) The blocking of pipes by solid hydrocarbons, as naphthalene is common enough where water gas is wholly or in part used, as in Toronto. In the case of acetylene the danger would not be as great, and with properly constructed generators and burners need not be realized at all.

(8) There is some possibility that in the residue from generators there might be small pieces of undecomposed carbide mixed with the lime. These would slowly give off gas, which, by contact with flame, would, it is thought, be a source of danger. I have examined such residues, taken from a large generator while in action, but could not succeed in detecting, by flame test, the presence of inflammable gas. Generators are mostly fitted, for economic reasons, with a grating, which only permits of a passage of small pieces of carbide, or residue. I do not think such residues are as dangerous as wood ashes as removed from domestic stoves. The above enumeration fairly exhausts the list of risks involved in the manufacture and use of low pressure acetylene. The next point of enquiry is that of ascertaining whether these dangers have been actually realized. In order to carry out this purpose I have searched for records of accidents the files of likely periodicals, and have succeeded in finding notes of a few cases, though in most of the accounts the information is meagre, and in some instances indefinite, especially as to the state of compression of the gas. To these you will doubtless be able to add others from insurance records. The following is not given as being complete, but simply comprising all the cases which I have been able to find:

Accident alluded to by Smithells, in remarks on Berthelot and Vieille's communication to the French Academy of Science. Carbide in generator thought to have become incandescent from insufficient supply of water. Particulars not given, nor pressure of gas stated. A plumber at Egremont, Cheshire, constructed and used an acetylene apparatus. Supposing the "receiver" to be empty he took off the cover, the result being an explosion by which he was so much injured that death shortly after resulted. The coroner thought the explosion was caused by the admixture of air with the gas remaining in the receiver. There is here a possibility of the presence of spontaneously inflammable phosphoretted hydrogen. Infante reports the explosion of a home-made apparatus. Smithells thinks that it was due to phosphoretted hydrogen, and that the receiver contained air. Two explosions took place in New York from the escape of gas from acetylene apparatus. The presence of flame might here be presumed. Another New York accident resulted from the cover of a generator being removed while a lighted candle was in close proximity. An explosion is said to have taken place lately at Arkona, Ontario, by which several persons were slightly injured. The owner is stated to have been in the act of showing the apparatus to some of his friends, a lamp being used as a source of illumination. Explosion followed the removal of the cover of the generator. The last four accidents evidently took place with low pressure acetylene, and were all probably due to the proximity of flame. This indicates what I believe will prove to be the chief source of danger.

### GENERAL CONCLUSIONS.

(1) Calcium carbide factories may be classed in the same category as iron foundries, with the additional risk incident to electrical plant.

(2) The storage of carbide should be subject to the conditions governing that of inflammable liquids. Packages to be of sheet steel, of at least twenty-seven gauge, well tinned, having seamed and soldered joints, and furnished with water-tight metallic caps. Packages to be further protected by being enclosed in strong wooden cases. Place of storage to be well ventilated, dry and well drained.

(3) Carriage of carbide, by water, to be held to involve extra risk.

(4) Carbide to be free from phosphoretted or siliciuretted compounds, as determined by analysis, or assured by guarantee.

(5) Apparatus for generating acetylene to be inspected and approved before use, and to embody certain general features of construction to be hereafter specified.

(6) Rooms for the installment of apparatus to be well drained, free from dampness, and provided with sufficient overhead ventilation communicating directly with the open air. No fire, flame, or artificial light to be allowed in apparatus room, nor are such places to be used for any other purposes than that indicated.

(7) Manufacture of gas to be carried out by a properly instructed and capable person, and never to be attempted except by daylight.

(8) Residues from generator to be removed by daylight, and directly deposited at a proper distance from any building.

(9) The use of acetylene gas, for lighting purposes, need not be placed under any special restrictions when the apparatus is not located in the building, and at a safe distance from it.

### USE OF COMPRESSED AND LIQUID ACETYLENE AND CARBIDE LAMPS.

It is more than probable that this question will, in time, become of considerable moment, and demand attention. In view, however, of the serious accidents which have already occurred, even in the laboratories of the most experienced gas chemists; and until the peculiarities of compressed and liquid acetylene are more perfectly understood, and better control apparatus has been devised, I think the underwriter may most profitably decline all business involving risk with these dangerous substances.

I have formulated, and herewith enclose a draft of regulations governing the installation and use of gas machines. I have the honor to be, Sir,

Your obedient servant,

E. B. SHUTTLEWORTH.

Toronto, Nov. 12th, 1897.

RULES FOR THE INSTALLATION AND USE OF ACETYLENE GAS APPARATUS.

(1) No generating apparatus shall be installed without the approval of the company has been obtained. Such approval shall only be granted after proper inspection by a qualified person appointed by the company. Makers of apparatus may have any particular design inspected, and to this end shall submit the necessary drawings and specifications and shall provide facilities for examining and testing the machine. If the inspection prove satisfactory the approval of the company to this particular form of apparatus may be secured provided the manufacturer signs an undertaking that the construction and design of such apparatus shall remain unchanged and in conformity with the drawings and specifications deposited with the company. The cost of inspection must be borne by the party who makes the application. Approved apparatus shall embody the following features: Generator and gas holder to be of proper relative proportions, and both of sufficient capacity for the requirements of the gas consumption of one day. Generator, gas holders and connections to be substantial; not subject to corrosion, and free from any parts of copper or its alloys. Pipes and connections to be of sufficient size and not subject to clogging. Adequate provision by liquid seals for the relief of gas pressure greater than that of three inches of water; and for the free discharge of surplus gas in the open air. Reliable automatic device for bringing the carbide into contact with the proper quantity of water.

(2) Location of apparatus. No apparatus shall be put into operation in a room in which there is a fire, or where any artificial light is used, even momentarily; or where the temperature is liable to fall below the freezing point. Apparatus room shall not be used for any purpose other than the manufacture of gas, and the storage of the necessary quantity of carbide. They shall be well drained, free from dampness, and provided with sufficient over-head ventilation communicating directly with the open air.

(3) Working of apparatus. All operations shall be conducted by daylight, and only by persons properly instructed in such work, and whose qualifications have been approved by the company. Residues from generators shall be removed by daylight and at once deposited at a safe distance from any wooden building.

(4) Storage of carbide. Carbide for use must be of guaranteed quality; stored in packages of sheet steel of at least 27 guage well-tinned, having seamed and soldered joints, and furnished with water-tight metallic caps. Such must be kept only in the apparatus room.

(5) The manufacture and use of acetylene at higher pressure than that of three inches of water is absolutely prohibited. This restriction to extend to carbide lamps.

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—The Ontario Government still has the power question before it, and from present indications some measure of relief is contemplated. It is impossible for a Government which showed such wisdom in its timber policy to stultify itself by continuing its old anti-Canadian policy.

—A correspondent informs us that he has been making experiments with acetylene gas as a motive power for gas engines, and finds that when running at high speeds, he can get more power out of acetylene gas than out of coal gas. Experiments were made in a rotary engine, and showed that quicker explosions could be got from acetylene than from coal gas. When running at speeds under 300 revolutions per minute, the difference is not much, if any, in favor of acetylene; but at 450 revolutions per minute the advantage is quite marked, and by getting heavier compression he has been able to run the speed up to 750 revolutions per minute, with marked results in favor of acetylene.

—The good things of Canada are, perhaps, after all to be preserved for Canadians, and the resources of our country used to develop it. The Ontario Government has followed out the policy outlined in THE CANADIAN ENGINEER and the press generally, and has passed a bill obliging the holders of new timber licenses to manufacture the logs they cut in Canadian territory by Canadian labor and on Canadian soil. The Dominion Government has, it is just announced, decided to limit the exportation of natural gas. If sufficient pressure can be brought upon the Dominion Government to induce it to bring into operation duties against the export of unrefined nickel, we may see prosperity ahead of Canada at last.

—McGill University is once more to be indebted to W. C. McDonald for princely gifts. He recently announced his intention of endowing a second chair of Chemistry with $200,000. This, added to the former gifts of the Chemistry building, equipment, maintenance, and the endowment of the professorship, makes a total of $575,000 to this department. The Faculty of Law is also to be fortified by the addition of $50,000 to the endowment of $150,000 furnished a few years ago. In addition to this Mr. McDonald intends to institute an auxiliary fund of $200,000 to be used for the general needs of those departments which are connected with his name. Mr. McDonald's gifts to McGill now amount to nearly one and a half millions.

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## THE MICHIPICOTEN GOLD FIELDS.

The Ontario Government in September commissioned A. B. Willmott, M.A., B.Sc., to examine the Michipicoten mining division, which had just been created, owing to the reports received by the Government of extensive finds of gold in that neighborhood. The following paragraphs are condensed from Prof. Willmott's report to the Bureau of Mines, recently issued by it in pamphlet form:

"Except a very small area at Cape Gargantua the rocks of the Michipicoten division belong to the Laurentian and Huronian systems. Of the former system, the almost universal rock is gray gneiss, finely grained, and not particularly well stratified. At many places it becomes thoroughly granitic in structure, and then is often coarser-grained. At a few places it was quite pegmatitic. While usually a dull grey in color, there are limited localities where a red felspar has given brighter tone to the rock. Syenites are found in small areas. The Huronian rocks are more varied in character. Massive diorites, diabases and hornblende, and chlorite schists are most common. Slates, felsites, quartz porphyries, quartzites and sericite schists are less common. Occasionally conglomerates were seen. At the contact between the two it always appears that the Laurentian gneiss or granite has been erupted into the Huronian rock, and is therefore later in age. The schists are nearly always vertical, and strike in various directions, depending on their relation to the intrusive granites. No clear distinction could be seen in the field between eruptive granites and the ordinary gneiss, and no case was observed where a granite had been erupted in the gneiss. Dikes of diorite are, however, frequently found in both the Laurentian and Huronian rocks.

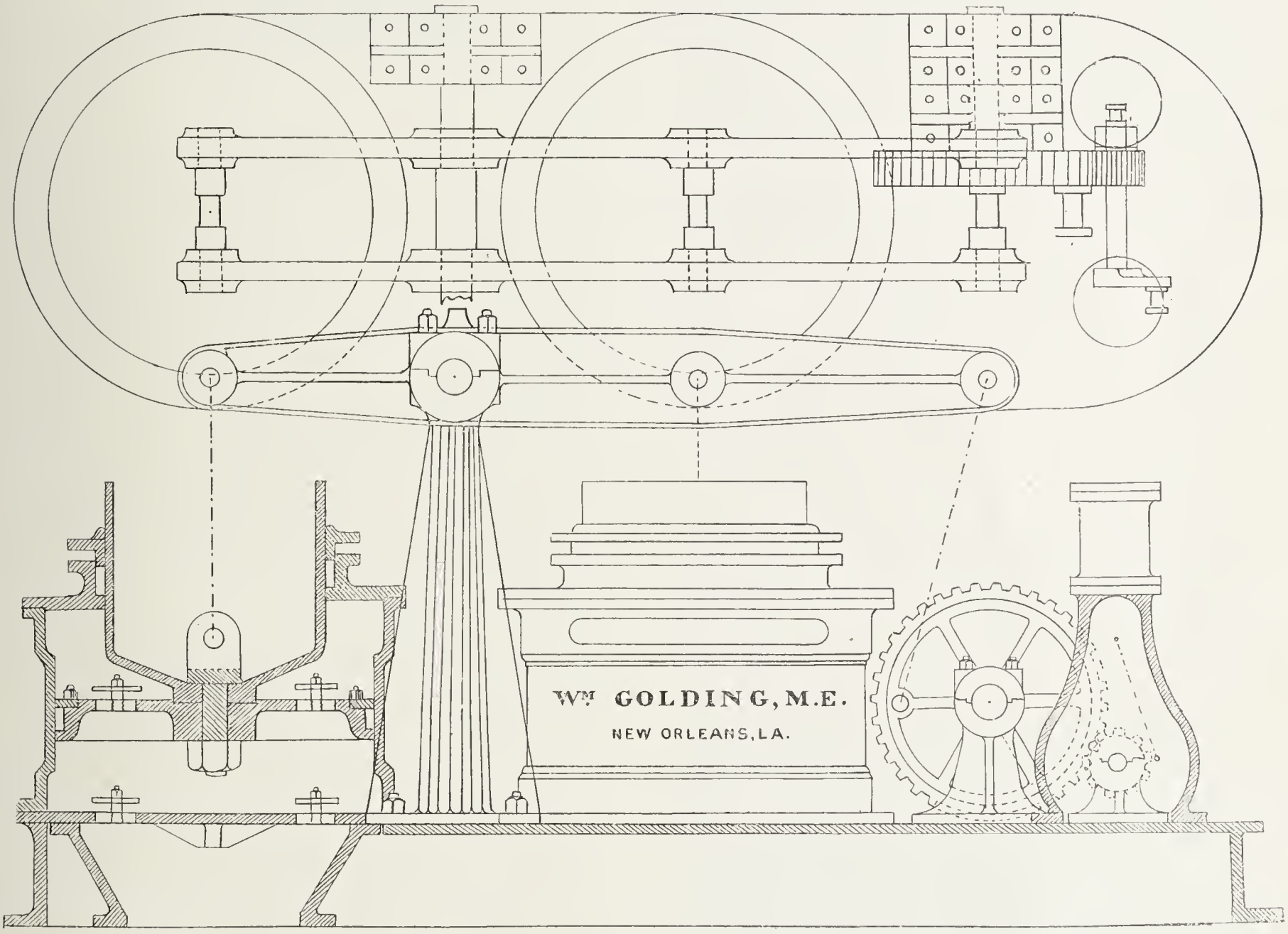
The metal most likely to be found in large amounts in this district, is gold, though discoveries of nickel, iron, copper and silver have also been reported. Almost nothing is yet known definitely as to the occurrence of any of these. Gold has been found at a number of places in visible particles, and in all cases simply chipped from the surface. At no place in the division has a pit been sunk to a depth of over ten feet, and in all the recent prospecting for gold not more than a single shot has been put in at any one point. What little prospecting has been done has been entirely confined to Lake Wawa and the canoe route north to Missanabie. Even here few men have gone more than three miles inland. At the most, a strip

six miles wide by forty long has been examined, and this in the most superficial manner, for several reasons. Many of the prospectors who have recently turned their attention to the field are utterly unfitted for the task. Fully three-fourths of those I met did not know how to pan, and could not tell when they had quartz of value," says Prof. Willmott. "Even for experienced woodsmen this region is a hard one to prospect. The cliffs are so steep, and in some regions the rocks are so completely enshrouded in moss that it takes days to prospect a very small area. The number of quartz veins seems to be large, to judge from reports given me by prospectors. Many of those I saw were very wide, and not infrequently formed the precipitous sides of high cliffs. In this case they are somewhat easily traced, often for a considerable distance. In nearly every case the veins are bedded ones, following the strike of the schists. On the whole the quartz seems white and does not usually carry any large amount of sulphides. Iron and copper pyrites are the chief minerals of the quartz, though galena and pyrrhotite are occasionally found.

So far the best finds are in the vicinity of Wawa Lake and on Manitowick Lake. Similar country rocks are, however, widely spread, and equally good deposits are quite as likely to be discovered in the future. Only a fringe has yet been prospected. As to placer gold, the early reports have proved to be false. The present streams are but reassorting glacial drift, and it is not probable that gold will be found in their beds. As to their old valleys, the case may be different, but no one has yet reached them. As to other minerals, little can be said. Native copper occurs in considerable amounts on Michipicoten Island, in the formation which on the south shore is proving so remunerative. Cape Gargantua is composed of the same formation."

## IRRIGATING PUMP.

The accompanying illustration shows a type of pump, suitable for moving either air or water, and designed especially for irrigating or draining land, where the lift is beyond the economic capacity of the centrifugal pump, and where large volumes are required to be moved. The feature of this combination is, that it can be operated by any power available, either by electricity or by a small steam or oil engine. The pump portion is of the type known as the "bucket plunger." The plunger, being one-half the area of the cylinder, will displace one-half the volume, while descending, and one-half while ascending, thus effecting a continuous discharge. The suction pipe to each will be independent, so that one pump can be used for circulating, while the other is being used for vacuum or other purposes. As will be observed, the combination is entirely self-contained, and may be lightened to any extent for facility of transportation. The engraving is made to scale of half-inch to the foot, for a combination having capacity to move five thousand gallons per minute. This pump is designed by Wm. Golding, M.E., New Orleans.




## THE GEOLOGICAL SOCIETY OF AMERICA.

The tenth annual meeting of the Geological Society of America was held in the Redpath Museum, McGill University, Montreal, from 28th to 30th of December.

The ballot for the election of officers resulted as follows: President, J. J. Stevenson, New York city; First Vice-President, B. K. Emerson, Amherst, Mass.; Second Vice-President, G. M. Dawson, Ottawa; Secretary, H. L. Fairchild, Rochester, N.Y.; Treasurer, I. C. White, Morgantown, W. Va.; Editor, J. Stanley-Brown, Washington, D.C.; Librarian, H. P. Cushing, Cleveland, Ohio; Councilors—W. M. Davis (for unexpired term of B. K. Emerson); Robert Bell, Ottawa; M. E. Wadsworth, Houghton, Mich.

At the evening meeting Dr. Dawson introduced the retiring president, Dr. Edward Orton, who delivered the annual address, selecting for his subject the "Geological Probabilities as to Petroleum." He referred to Sir William Dawson as standing high in the list of those who had preceded him in office, and said that, standing within the precincts of McGill University, they might adopt the words: "Si Monumentum requiris, circumspice." He then proceeded to point out some of the principal geological probabilities as to petroleum and its derivatives, and stated that the subject he had chosen for his address had some peculiar claims on geologists. Petroleum was a form of stored power, and geologists knew better than other

men the priceless value of such accumulations. Geologists knew that on them the well-being and progress of the race largely depended, and that without them civilization could not long maintain the pace which the nineteenth century had set. They knew that these stocks of buried light, heat, and power were small at the best, and that they demanded the most careful husbandry. They knew, too, that petroleum and its derivatives, by virtue of their essential characteristics, were especially opposed to waste, either through ignorance, recklessness, or speculative greed, or through all combined. It would be a reproach to have the experience of Pittsburg and some other places indefinitely repeated; it would be a lasting reproach to have the important exploitation of petroleum restricted by the exhaustion of its stocks before the end of the century in which it was begun, and fifty years of which still remained.

The programme included some thirty papers, and of those most interesting to our readers, Prof. Chamberlain read one by Prof. Warren Upham, on "The Niagara Gorge and St. David's Channel." The writer said that having recently again examined the Niagara Falls and gorge, with especial reference to the older channel of St. David's, the author believes that a most important element in the history of the gorge erosion has been overlooked by some observers, and that by others its evidences have been misunderstood. This paper shows that the small preglacial stream which eroded the St. David's and Whirlpool channel, having a great depth beneath the river in the whirlpool, must have flowed for a considerable distance, before reaching that depth, in a gradually widening and deepening ravine, coinciding with the present gorge along the Whirlpool rapids. Because the Niagara River found there a drift-filled, narrow ravine, which it cut to the present size of the gorge, its erosion took place in that part by rapids and cascades. Southward from the head of the old ravine, the river has eroded its gorge by a great vertical cataract, under which the masses of the Niagara limestone, rolled about by the power of the waterfall, have worn the river bed to a maximum depth of nearly 200 feet beneath the water surface. The narrowness of the gorge along the Whirlpool Rapids is therefore attributed to the conditions of the river erosion here indicated, rather than to decrease of the volume of the river by diversion of the water of the upper lakes to flow from Lake Huron eastward. Studies of the glacial Lake Agassiz convince the author that the progress of the epeirogenic uplift of the northern United States and Canada from the Champlain depression was too rapid to accord with the hypothesis of any outflow from Lake Huron toward the east during the long time that would be required for the Niagara River, while thus diminished, to erode the gorge along the Whirlpool Rapids. The explanation here given accords mainly with Dr. Julius Pohlman's discussion of the Niagara history, but differs concerning the age of the river and of postglacial time, which is estimated, as from Prof. N. H. Winchell's discussion of the Falls of St. Anthony, to have been between 5,000 and 10,000 years.

Frank B. Taylor, of Fort Wayne, Ind., contributed some "Notes on the Moraines of the Georgian Bay Lobe of Ice-sheet." He said, when the ice-sheet had retreated in the basin of Lake Huron so far as to leave the summit of Blue Mountain, south of Georgian Bay, uncovered, there still remained a well defined glacial lobe projecting towards the southeast, nearly to Toronto and eastward beyond Lake Simcoe. This lobe was divided in two parts by the Penetang peninsula, the larger one extending southeast from Nottawasaga Bay, and the smaller one extending east, southeast from Matchedash Bay. Recently the moraines of the eastern limb of the Nottawasaga lobe were partially explored and a well defined series of five moraines was found filling the interval from the head of Georgian Bay to the "Oak ridges" north of Toronto. During the later stages of this lobe there was a glacial lake covering Lake Simcoe and a considerable area to the east, and probably held up on that side by a lobe projecting from the north-east up the valley of the Trent River. Its beach is 90 to 100 feet above Georgian Bay, running S. 60 deg. E. Some of the moraines running along the east side of Lake Huron were also traced northward to the vicinity of Durham and Flesherton.

Prof. F. D. Adams, of McGill University, read some notes on the "Geology of Montreal and Vicinity." All of these papers were purely technical in their character, and were chiefly interesting to scientific men in general and geologists in particular. Prof. Adams' paper was a most exhaustive one, and dealt with the geological formations of this portion of Canada from the post-pliocene period onward. He especially drew attention to the volcanic nature of the district of Montreal; to the large deposits of Trenton limestone and Utica shale to be found hereabouts; to the presence of marine fossils at the base of the mountain, which, he said, went to show that the district now lying between the river and the mountain was at one time submerged in water and ice, thus making an island out of the mountain. The first shore line was in the middle of Beaver Hall Hill, the next at Dorchester street, and another at Sherbrooke street, besides several others, at which heights the river had remained for some time. The mountain is 800 feet high, and the highest shore line is 625 feet high, so that when the water was at its highest there was always a small island. He also pointed out the character of the different stratas of the earth and rock which had been met with in excavating the foundations of Montreal's principal buildings, and in conclusion gave a brief summary of the topography of the island and the changes which had taken place therein since the days of Maisonneuve.

Dr. H. M. Ami gave an account of "The Mastodon in Western Ontario," speaking particularly of the remains of three which had been found—two in Essex County, and one in Norfolk County—and describing the sedimentary formations in which they occurred.

Dr. Robert Bell, of Ottawa, read two papers—one on "Mastodon and Mammoth Remains found near Hudson Bay," and another on "Fossil-like Forms in Sault Ste. Marie Sandstone." Under the former heading he gave an account of the discovery of some mastodon bones in 1877 near the junction of the Mattagomi and Missinaibi rivers, to form the Moose river, in the southern part of the basin of Hudson Bay, and describes the superficial deposits in that region, and of the finding of a peculiarly small mammoth's tooth on Long Island off the Eastmain coast of Hudson Bay. He discussed the question of the specific identity of this small mammoth with the common species of more southern latitudes in North America. Under the second heading he stated that in the bottom of the pit which was excavated in the sandstone for the canal lock on the south side of the Sault Ste. Marie in 1891, a bed was found covered with very distinct markings, which in some respects resemble large plant remains, but they are probably casts of desiccation cracks. The author's remarks will be illustrated by photographs of four large specimens.

Prof. A. P. Coleman treated of "Clastic Huronian Rocks of Western Ontario, and the Relation of Huronian to Laurentian." He spoke of the rocks themselves, and of their arrangement in the region; and a few remarks on the same subject were made by Dr. Bell, who had worked geologically in that district.

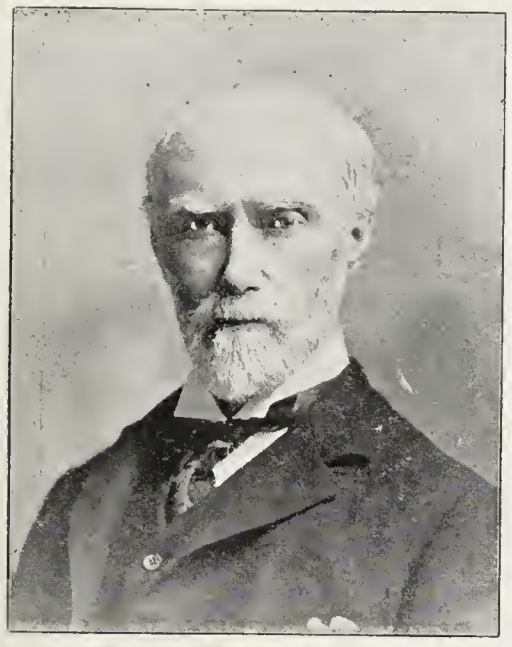
Other papers of Canadian interest were contributed by Sir Wm. Dawson, R. W. Ellis—Notes on the Sands and Clays of the Ottawa Basin; Bailey Willis—Drift Phenomena of the Puget Sound Basin; Frank D. Adams—Nodular Granite from Pine Lake, Ont.; Nevil N. Evans—Chemical composition of the Granite from Pine Lake, Ont.; E. A. Barlow—On the occurrence of Corundum in North Hastings, Ont.; Frank D. Adams and Jno. T. Nicholson—Experiments on the flow of rocks now being conducted at McGill University.

## FIFTY YEARS IN TELEGRAPHY.

The Toronto Club gave a complimentary dinner on December 22nd to H. P. Dwight, president and general manager of the Great North-western Telegraph Company. The occasion was the 69th birthday of the guest of honor, and the celebration of the jubilee of his connection with the telegraph service. Many of the most distinguished men in Canada were present at the banquet, and letters of regret were read from others who were not able to be present. In replying to the toast of "the guest of the evening," Mr. Dwight read a sketch of his early life and connection with the telegraph business, from which we take the following extracts:

"I was brought up," said Mr. Dwight, "on a small farm of 25 acres, near Oswego. When about eighteen years of age the erection of a telegraph line had just been completed between Oswego and Syracuse, and I made application and obtained permission to enter the Oswego office in order to learn the business of an operator. I had heard about this time that a

telegraph line was being built by the Montreal Telegraph Company in Canada, where I obtained employment on the line which had been erected during that season between Quebec and Toronto, a distance of 500 miles, on which some 12 or 15 offices were being opened. Mr. Wood, I might mention, was



H. P. DWIGHT.

the first pupil of Prof. Morse, and one of his most intimate friends. We took instruments along with us, and opened the office in Belleville the following day, where I was left in charge and where I performed the duties of both operator and messenger, and remained for a couple of months. At the end of that time I was ordered to Montreal, to take my place in that office as an operator, and remained there until the spring of 1850. While acting as operator I also acted occasionally as messenger, batteryman, line repairer, and in fact did everything more or less that was necessary to be done in connection with the business of the office. During the time I was in Montreal our staff consisted of four or five persons, O. S. Wood, our superintendent; myself, as chief operator (and sometimes the only one), one or two clerks, and one messenger, a faithful old soldier who delivered messages with a good deal more reliability than speed.

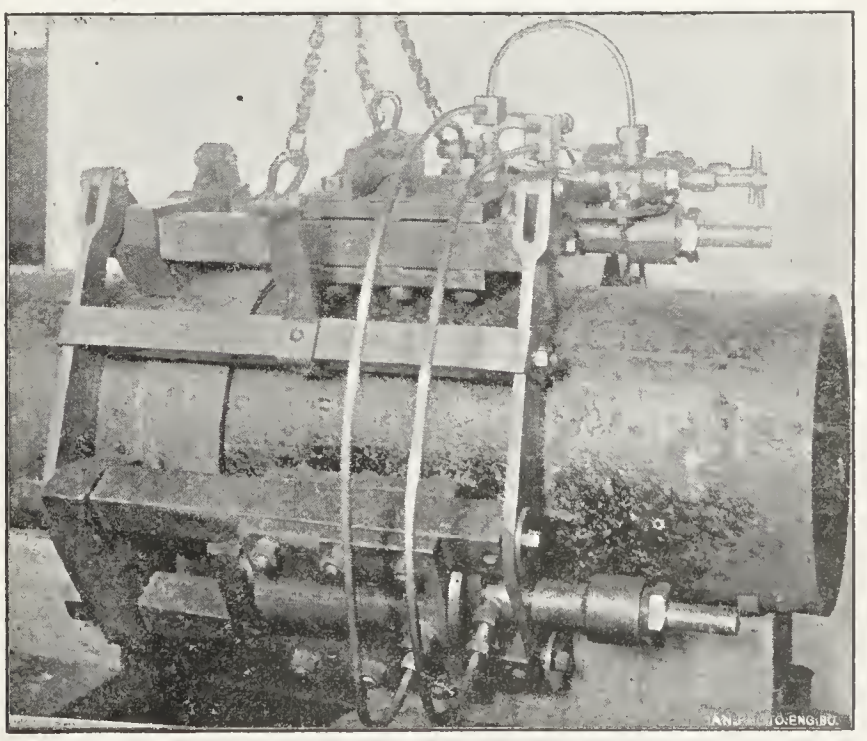
In the spring of 1850 I was sent to Toronto to take charge of the company's business here, and to be in a position to recommend such extensions in the Province of Ontario as might seem desirable. During my first year in Toronto I sent and received myself on the instruments every message which passed over the line to and from this point. I had not been long in Toronto before I began to suggest to the head office various extensions of our lines, and as these suggestions were almost invariably adopted I grew bolder and more reckless, until the head office began to get nervous and frightened. It was finally concluded, however, and I was notified by our superintendent, that I should do as I liked, it only being required that I should give notice each winter of what lines I proposed to build during the ensuing season. During the following years arrangements were made for building a line along the Great Western railway, and from time to time other railways, as they were projected and built in Ontario, such as the Port Dover & Lake Huron, the Toronto & Nipissing, the Northern, North Simcoe, Port Hope, Peterborough & Lindsay, the Midland, Grand Junction, Hamilton & Lake Erie, Hamilton & Northwestern, Lake Simcoe Junction, Welland, Whitby & Port Perry, the Victoria, the Toronto, Grey & Bruce, etc. Not only did we arrange to build lines along these different railways, most of which were afterwards consolidated with the Great Western, and the Great Western, and finally all the others with the Grand Trunk, but we also covered all the principal highways in the province. I remember well an occasion when a rather sarcastic enquiry came from the secretary of the Montreal Telegraph Company as to whether I had found any more sawmills to which I proposed to extend the lines. The policy of extension adopted, however, turned out to be a fortunate one, and to-day the map of wires covering the country looks like a thickly-woven spider's web through which a fly could scarcely escape. There is hardly a town or village of the least importance in the country which is not included in this network of lines, to say nothing of the present telephone system, so that instantaneous electrical communication is almost within the reach of every man's door.

When I commenced my career as an operator there were only two railways in the country; a short line of nine miles between Montreal and Lachine, and the other between La Prairie and St. Johns. There was not a mile of railroad in Ontario or any other part of the Dominion, and as illustrative of how one enterprise may help another, it may be said that railway traffic is enormously increased by the assistance rendered by the telegraph in facilitating the movement of trains. The tariff on messages in the early days was reckoned in Halifax currency. On any extensions of the lines a small additional rate was charged, until after a great many extensions charges ranged from 1s. 3d. to 5s. or 6s., and it became a question for careful consideration as to how the matter might be simplified. My advice was asked in the matter, and I procured statements from all the different offices showing the exact number of messages handled under the different rates. It was discovered that over 90 per cent. of the messages sent were under the lower rate, and consequently between offices the nearest to one another. I submitted a report to show that the difference between these high rates and a uniform rate of 25 cents would involve no great loss to the company, while it would appear to the public a very great concession, and recommended that the uniform rate should be adopted, which was done. The consequence was that business soon began to increase between the remoter points on the line.

Our system of telegraphs is in some respects precisely the same as when I learnt the business 50 years ago, but there have been many ingenious improvements made in the instruments, and in the use of the wires. One of these improvements is what is known as the quadruplex system—that is, the use of one wire between two terminal points—Toronto and Montreal, for instance—made to answer the purpose of four—one real wire, three phantom wires. Four operators do duty at each end of the line and work independently, precisely as if there were four separate wires. Before this method of using the wires was discovered such a thing would have seemed as impossible as it would now to make a single railroad track answer the purpose of four independent lines. These electrical matters are full of wonders.

## RING JOINT FOR PIPES AND TUBES.

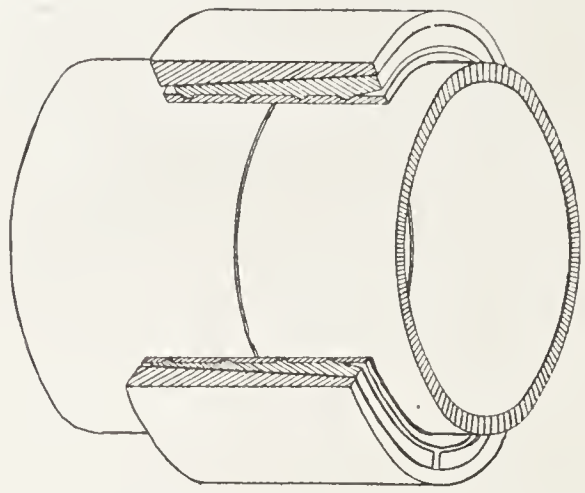
An interesting exhibition of a new method of joining iron pipes was recently given at John McDougall's Caledonia Iron Works, Montreal. It is known as the Ring Joint method, and the necessary parts are a strip of cold sheet lead, a wedge ring, made from a bar of iron or steel, ridged along its interior length, sheared to size and bent into a ring with open ends, and a compression ring, which is a rigid collar of wrought iron or steel on a plain casting, having its inner surface tapered to the form of the wedge.



The application of this joint is simple in the extreme. The strip of sheet lead is placed around the pipe with its ends slightly overlapping; over this is placed the wedge ring and the rigid compression ring is lightly fitted over the whole. The pipes are then carefully adjusted and the series of rings placed over the joint. By the application of mechanical or hydraulic pressure the compression and wedge rings are forced closely together. The wedge ring, being open, is powerfully contracted by the collar and thrusts its ridges into the

sheet lead, contracting it at the same time, thus producing a contact which approaches positive amalgamation.

This joint can be used on any kind of pipes—cast iron, welded or riveted iron and steel pipes, or on rolled longitudinally seamed pipes, such as Williams' patent. No bell sockets or specially formed ends are necessary, and cut pipes may be used. There is no waste of lead, and, since it is quite cold, no injury need result to the composition on coated pipes. The joint can be quickly removed by a few smart taps with a hammer on the compression ring, and without any damage or loss of material.

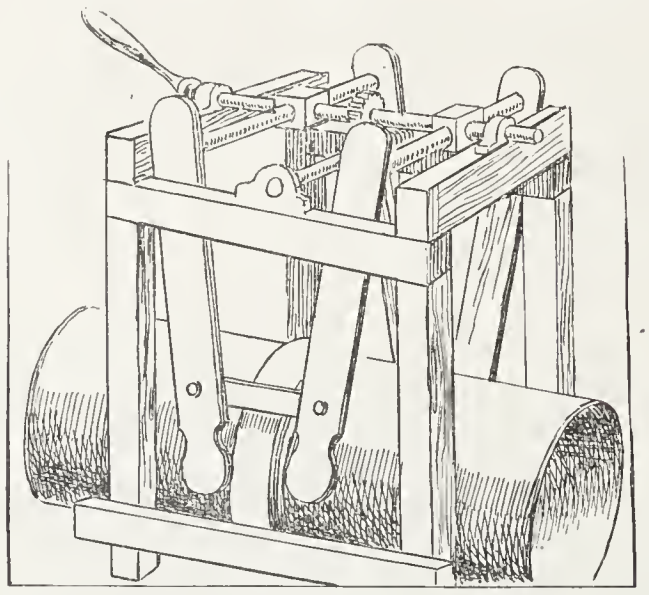


RING JOINT SHOWING METHOD OF APPLICATION.

The joint may be employed in dry or wet trenches, or under water, and is applicable to all diameters ranging from ordinary gas tubing up to the largest street mains, and is suitable for all work for which cast iron pipes are used in conveying gases, vapors and fluids.

For closing the joint on pipes and tubes of small diameter, the machine employed is a combination of tongs operated by hand screws. Pipes of large diameter are joined by means of a machine consisting of three small hydraulic presses operated by a hand pump. These tools are easily portable and can be carried along the pipe track by hand, or suitably mounted on a hand cart.

During the exhibition two iron pipes of about 18 inches diameter with plain ends were joined by this method and subjected to a water pressure of 400 feet with perfect success. The inventor is D. J. Russell Duncan, of Victoria St., London, who was in Canada recently and is already known to our readers, and the sole agents for Canada are J. W. Pyke & Co., of 35 St. Francois Xavier St., Montreal.



A number of well known engineers and manufacturers who witnessed the experiment, expressed their confidence in the success of the process, and it is the intention of Messrs. Pyke & Co. to put the new process on the Canadian market by either leasing the machines on royalty to users or selling the rights to manufacture the machine. They are open to negotiate with responsible parties to this end.

## LITERARY NOTICES.

The National Brick Manufacturers' Association of the United States appointed a commission in February, 1895, to make such tests of paving brick as could be used as standards. This commission has now reported in a pamphlet of 110 pages, containing 34 tables of tests and a large number of diagrams, of great importance to every engineer who has to deal with the brick-paving problem. These tests and calculations are issued as being thoroughly reliable, the committee having in view especially the establishment of standard tests that would prove ample for municipal authorities.

Those who have read the book "In the Days of the Canada Company," by the Misses Robina and Kathleen M. Lizars, will be keen to read any fresh contributions from the same source, and when a new book was announced the other day dealing with the rebellion times in Canada, there were confident anticipations of a good treat. The book has appeared and our anticipations have been realized. "The Humors of '37," is not an ill-chosen title as might at first sight appear, for taking the word humor in a broad sense we have in this a judicious and appetizing mixture of "the grave, the gay, and the grim." We should expect in a book on this subject plenty of the grave and grim, but we do not always associate gaiety with treason, though fun is often tumultuous. In this work of 369 pages, the reader will, however, find instruction and amusement combined with a tact and instinct possessed by few writers. To the old, the "Humors of '37" will recall many a scene of those exciting days, while to the young it will give much solid information in an entertaining garb relating to a great crisis in Canadian history. The book is published by Wm. Briggs, Toronto, and like all the recent publications from this house is excellently printed.

Undoubtedly the book of the year on South Africa is that written by Poultney Bigelow, at the request of Harper Bros., New York, by whom it is published. It was fortunate for the author that he had written his other interesting book, the "History of the German Struggle for Liberty," before his visit to South Africa, instead of after, for he had thus opportunities of comparing German official methods with British methods in relation to the Dark Continent, and while he writes with an American's prejudice in favor of the republican form of government, and is most enthusiastic in his admiration of President Steyn, of the Orange Free State, and Paul Kruger, of the Transvaal —to the former he dedicates the book—he gives enough light on German and Hollander official character to show the Boers what their fate would be if they fell under control of those countries. Our author admits that the surrender of the Transvaal to the Boers in 1881, though magnanimous, was a mistake. "The Boer Government to-day is applying to a complex modern community administrative principles fit only for a community of cattle herders and teamsters." The recent agitation which led to the Jameson raid "was not an English rebellion against Dutch domination, but a union of Americans, Afrikanders, English—in short every white man who was not an official of the Boer Government, was heartily in favor of a reform in the Government." The Boers confessed their incapacity for governing a modern State by enacting that revenue was to be raised by selling monopolies. "The political economy of Spain in the days of Philip II. was applied by Paul Kruger of 1896 to a community of the most modern and progressive manufacturers ever assembled together in one spot."

The convention number of the *Street Railway Journal*, of New York, is a splendid monument of enterprise in American trade journalism. This number contains 361 pages, of which 133 pages are reading matter. The advertising pages are quite as interesting as much of the reading matter, and large sums of money must have been spent by various manufacturers on designs for their advertisements. Each copy of the paper weighed 4 lbs., and the postage abroad was 32 cents for a single number.

"Across the Sub-Arctics of Canada" is the title of a very important contribution to our scanty knowledge of our great northern regions about Hudson Bay, by J. W. Tyrrell, C.E., of Hamilton, brother of J. B. Tyrrell, of the Geological Survey. It is an instructive account of a journey of 3,200 miles by canoe and snowshoe through the "Barren Lands" to the west of Hudson Bay, undertaken by the author and his brother in 1893. The expedition left the railway at Edmonton, N.W.T., and descending the Athabasca River to Athabasca Lake took its way by the chain of lakes and rivers to Chesterfield Inlet, thence coasting along Hudson Bay to Fort Churchill and York Factory, and from there through the forest down to Lake Winnipeg, and home *via* Winnipeg. Mr. Tyrrell treats of the customs and habits of the Indians and Eskimos met with, the game, fish and economic animals, the timber, minerals, etc., and gives much information on the geography, botany, geology and general natural features of the country traversed. Maps and numerous illustrations add interest to the work, which makes 280 pages, and a valuable appendix gives a catalogue of plants collected on the trip, while another appendix contains a vocabulary of Eskimo words and phrases. We hope to give a more extended notice of this book, and meantime commend it to all who would learn more of our great heritage in the north. Published by Wm. Briggs, Richmond street west, Toronto.

The December issue of *Power*, New York, is an international number, and its table of contents is printed in German, Spanish, French, and English. The leading article is a description of the proposed power station for the Metropolitan Street Railway Co., New York

"Power Catechism," being correct answers to direct questions covering the main principles of steam engineering and the transmission of power, has just been issued by the publishers of our able contemporary, *Power*, of New York. There are 735 questions answered, followed by tables from which various calculations can be made by the steam engineer, the whole making 226 pages, illustrated by numerous diagrams. Price $2.

Those interested in bicycles who wish to study the theory of what constitutes a perfect bicycle bearing should get the new catalogue issued by the Canadian Typograph Company, Windsor, Ont., manufacturers of the celebrated "E. & D." bicycle. The illustrations are very clear, and the catalogue is worth studying for its lucid explanations of the mechanical points of the bearing.

E. Leonard & Sons, engine and boiler manufacturers, London, Ont., have just issued a new catalogue (No. 30), containing 44 pages of matter showing some of their best types of engines and boilers. This Company manufacture the Leonard-Ball automatic cross compound engine, and Leonard-Ball tandem compound automatic engine, and simple automatic engine. They also manufacture the Leonard-Tangye engine, which is made in sizes from 50 to 200 h.p., and the Leonard-Clipper engine, which is a new type made in 7 sizes from 15 to 50 h.p. The catalogue gives a bird's eye view of the large works of the Company, and a few interesting facts of the history of the firm, which began business as far back as 1834, its London history dating from 1838. The catalogue will be mailed to anyone interested.

The Industrial Publication Co. of New York, have issued the first number of a series of handy books on mechanical subjects. The first issue treats of elementary principles of machine design as applied to steam engines, and is edited by J. G. A. Meyer, author of "Modern Locomotive Construction." It contains 92 pages and has a number of very clear diagrams and illustrations. The price is only 25 cents.

"The Year Book of the Society of Engineers of the University of Minnesota," at Minneapolis, makes a large pamphlet of 140 pages, and contains papers on nineteen different topics, some of which are very well treated.

The W. J. Johnston Co., 253 Broadway, New York, are to be congratulated on the enterprise shown in the compilation of their "Electrical and Street Railway Directory" of the United States and Canada. It is the only work of its kind in America, and gives a list of all the central lighting stations, electric, horse and cable street railways, telegraph companies, district messenger companies, telephone companies, mining plants and as full a list of the isolated electric plants as one could expect to find. It also contains a list of manufacturers of and dealers in electrical and street railway apparatus and electrical supplies In each department it gives a number of particulars showing the capacity of the plant, the capital employed, the officers of the company and other information bespeaking great care and labor in the compilation. The issue of 1897 makes a volume of 752 pages, and is substantially bound in cloth. Price, $5.

The American Machinist Publishing Co. has issued a neat linen covered volume of some hundred pages, "American and Other Machinery Abroad," which gives in an interesting way the history of the United States trade in Europe in machinery, and a host of facts as to its present position, as well as data upon which a prediction of the future may be founded.

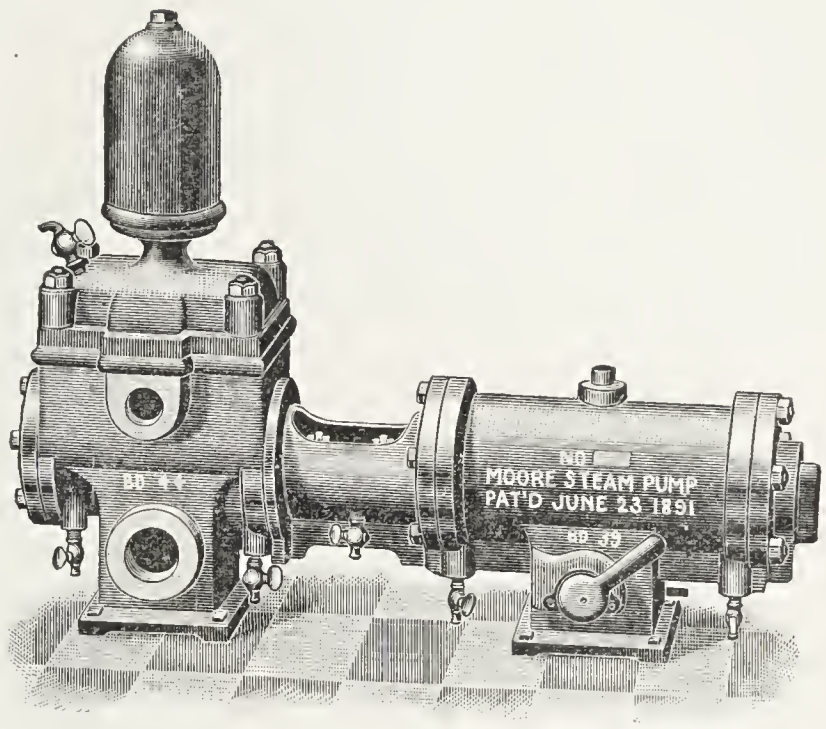
CALENDARS.

THE CANADIAN ENGINEER acknowledges with thanks the receipt of calendars from Morton, Phillips & Co., mfg. stationers; D. K. McLaren, agent for belting and mill supplies, 24 Victoria street; the Queen Insurance Co., the Alliance Assurance Co., the Insurance Co. of North America, the Northern Assurance Co., all of Montreal. The Conger Coal Co. (Toronto) calendar is one of the most up-to-date which we have seen. The view of Dawson City which adorns it is a very cooling sight indeed, as well as an artistic decoration. The Packard Electric Company, St. Catharines, Ont., wishes its friends a happy new year on its monthly blotting pad for January. A. B. Jardine & Co., Hespeler, Ont., have sent out a neat calendar, showing a picture of the village blacksmith, whose opinion is that "it pays to use the best tools." The B. Greening Wire Co., Hamilton, have repeated their famous historical calendar of last year, which shows the three generations of the proprietors, and a fine view of the Hamilton, Ont., works.

## THE MOORE STEAM AND VACUUM PUMPS.

The steam valve is placed on the body part of the piston, within the steam cylinder, with heads provided with suitable metal packing rings. Within the body of the piston are the steam ports, leading to each end of the cylinder, and registering alternately with the annular grooves or the valves in its actuation. The longitudinal sliding motion of the valve on its seat, is limited between the piston heads. The valve being carried on its reciprocation by the piston, until its head passes the steam inlet port in centre of steam cylinder, thus admitting steam between the valve head and piston head and forcing the valve against the opposite piston head; changing the relation between the annular grooves in the valve and steam ports in the piston, causing a reverse motion of the piston, and exhausting its steam into the centre of the piston, thence through the hollow piston rod into exhaust chamber between the stuffing boxes. By reason of the two steam ports in the valve seat being of different areas, the piston recedes gradually for a moment and then completes its stroke.

Its simplicity of construction, its small number of parts, its large wearing surface for the valve, together with its positive value motion, with no possible chance of its becoming balanced on its centre, through leakage or other causes, make it, the makers claim, the most desirable pump on the market.




By the method used in restricting the exhaust steam with the slow start and steam cushion for the piston, the speed of the pump is automatically regulated. Never running too fast to take suction, or fast enough to injure its working parts should the water supply give out, it can be regulated to supply water in the boiler to a uniform height without attention.

As it will work with a lower steam pressure than an injector, or most steam pumps, the boiler can be filled after stopping the engine, without an extra fire. As a boiler feeder this pump has no equal. It is made to couple on either right or left. With the working parts entirely closed, it can be set up in the most convenient place without fear of any damage from grit or dust. The stuffing boxes being enclosed in the exhaust chamber, there is no drip or escaping steam into the room, and by means of the lever on the front side of the pump, the exhaust steam and all drippings from the stuffing boxes can be thrown into the suction chamber to warm the water, and is then returned to the boiler.

This pump, the maker believes, avoids the sensitive qualities found in other pumps for similar purposes. Starts promptly and will clear itself. No skilled engineer necessary to operate it. This pump heats water to a degree of temperature higher than any other pump on the market. These pumps are built by an old established and responsible firm, and are guaranteed to be perfect in material and workmanship. They have had thorough and practical tests by experienced engineers, who unite in speaking in the highest terms of it. Darling Brothers, Reliance Works, Montreal, are the Canadian agents of the Moore Steam Pump.

## ARC LAMPS FOR CONSTANT POTENTIAL.

The Canadian General Electric Co., Limited, announces that it is prepared to furnish a satisfactory and economical arc lamp for constant potential, alternating current circuits. The problem has been a difficult one to solve, but the results obtained have, the company claims, warranted any apparent delay.

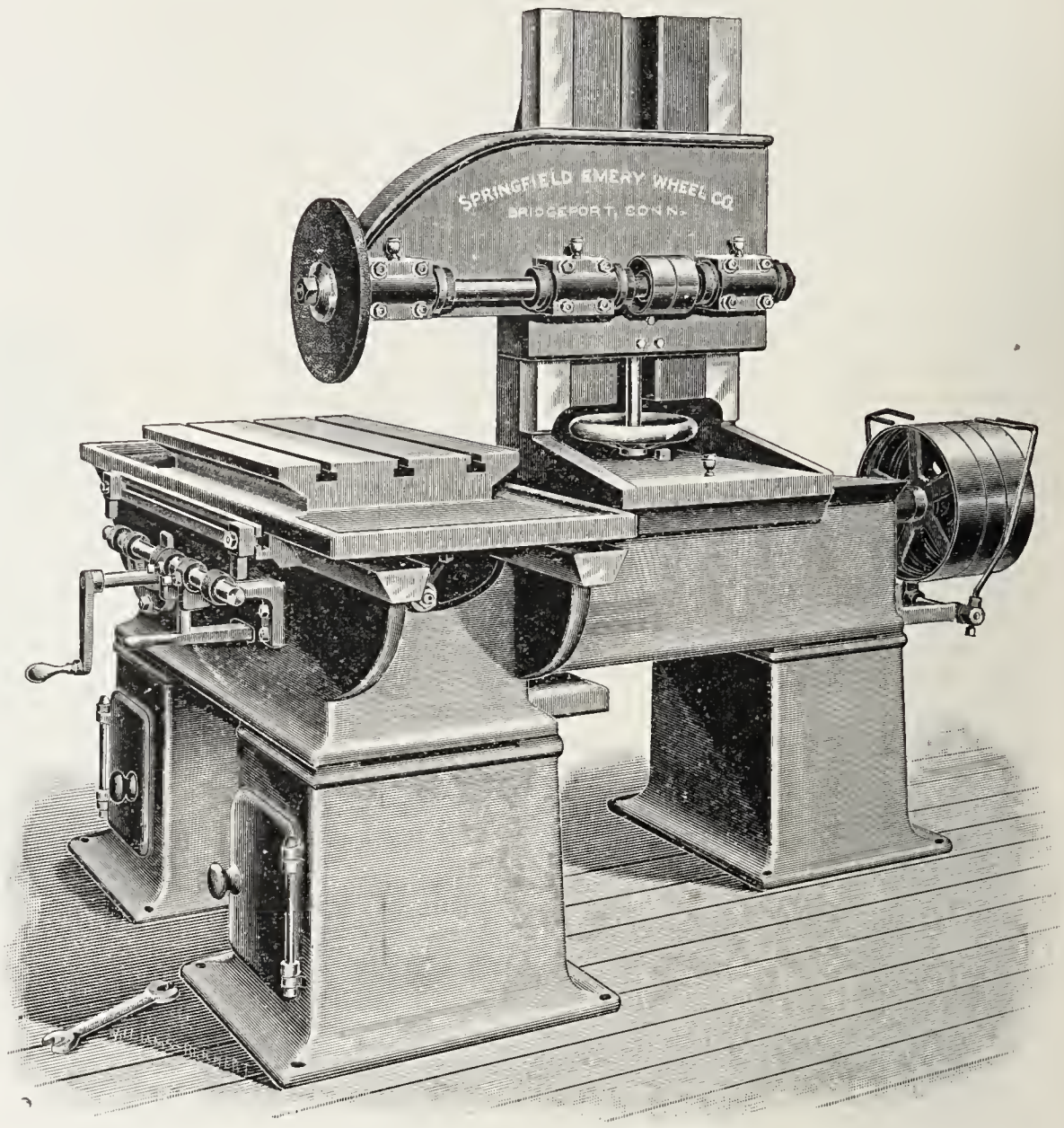
The principal features of the new lamp are briefly as follows: Small maintenance account, by reason of a life of 60 to 70 hours, with one pair of carbons. The lamp is simple in construction, has few moving parts and operates quietly. Great economy. Ninety-three per cent. of the energy is utilized in the arc. Operates independently on circuits of 100 to 120 volts, and frequencies of 60 or 125 cycles. The lamp requires 70 volts potential at the arc, and consumes 6 amperes. The difference in the potential at the arc and at the terminals is taken up by an inductive resistance, which is the unique feature of the lamp. This inductive coil does not consume in excess of 25 watts, and is placed within the interior of the ornamentation. The use of high grade carbons is essential.

The lamp is artistic in appearance and especially suitable for interior illumination. The ornamentation is finished in ground brass and black enamel.

## OPEN SIDE SURFACE GRINDER.

The accompanying cut represents a 2 ft. open-side surface grinder, a practical machine for surfacing flat surfaces up to 16 inches in width and 24 inches long, and will admit work 12 inches in under the emery wheel. The machine is fully automatic; the carriage is driven by a screw connected by bevel gears to the main shaft of the machine. The emery wheel head, to which the automatic feed is attached, is also driven by a screw, the end of which is shown with a crank attached on the front of the machine, which can be operated by hand or automatically as desired. These machines are made to take in work of different lengths from 24 inches to 144 inches.

For further particulars address the Springfield Manufacturing Co., Bridgeport, Conn., which also manufactures a large line of different varieties of surface grinders.




OPEN SIDE SURFACE GRINDER.

## PLUMBING.

*Editor* THE CANADIAN ENGINEER.

SIR,—I have read with pleasure the letter on sewage ventilation on page 238 of December number, and the three able articles on the disposal of sewage and sewage ventilation in your issues of April, September and November, and can bear out the remarks of "Constant Reader" by relating facts that have come to my notice, proving that the sanitary by-laws at present in force in Toronto, are made and enforced for the benefit of the officials more than to improve the public health.

At No. 243 Church st. there is a blacksmith's shoeing shop. At the rear end, on the line of Dalhousie st., stood an old dwelling house with a Philadelphia Hopper Water Closet. This house was pulled down to give yard room and more light, and an outside pit closet was built in yard with all new standard material, and the old closet and pipes were discarded. The position of the new w.c. was four yards northwest of the former position, but on the line of the same drain pipe, which had to be cut and shortened and one full W. Y. junction, one bend and one length of pipe connected to it to receive the soil and rain water pipes. This old 6-inch drain continued from the yard under the smith forge to Church st., about 70 feet, and connected with the street drain very properly, without the catch bag or running trap, as it is called, and stink pipe, usually termed the breather. The inspector demanded that the drain should be broken at the Church street line, and a trap and breather put in, which was done at a cost of about $15, the depth being nearly 13 feet. When he came to inspect, he found the work had been completed in a first-class, workmanlike manner, but his pocket level showed that the drain fell slightly the wrong way just at this point; but on digging down at rear end of shop, it proved that in the 70 feet length of smith's shop the drain rose four feet, or if a regular grade was given, it would be over ¾ inch to the foot, and as only three lengths of pipe was bared, it did not prove anything, because a sensible drain layer will keep the drain down at the delivery end, and rise at beginning end to give the flow a good start. However, the inspector ordered that the old drain should be bared, which he himself could see could not be done without removing the smiths' fires, bellows and anvils, lifting floor and digging at a 12 ft. depth.

It was rather remarkable that the diggers' pocket level showed the three pipes to be about level, with an inclination of fall towards the street; so also did a carpenter's level, and it puzzled a few why the inspector's level showed the fall to the contrary way.

The owner of the property saw that he could not easily please the man with unlimited powers, so he paid the city nearly $14 to put in a drain from Dalhousie street, and from the street line to pit w.c. in yard, put in a heavy cast iron drain pipe with local joints.

The weather at the time was at or belew zero, and the embankment of drain very dangerous, and the pipe-fitter made a written application for inspection and smoke test under the clause, which relates "That when soil is dangerous the inspection shall be made forthwith, and when the water test is not safe by reason of frost such test shall not be used." See by-law XI., page 11.

After waiting four hours a boy was sent to see when the inspector would please to come, returned with the order to fill the frozen pipes with water, and he would come and see them. This meant having them filled with ice and the destruction of the rubber plugs and iron traps that could not have been again emptied, before they became solid.

These facts prove that an unnecessary expense of about $100.00 and a troublesome delay and annoyance of several weeks, was given by this city official and by-laws, to secure an outside privy to accommodate five working smiths, though every foot of drain under the smithy floor, was, where seen, first-class in material and workmanship, and covered with about seven feet water-tight stiff clay, that would not let sewer gas penetrate.

*Query:* Is it the public or the public servants that secure the advantages of the public health by-laws in this case. Let us cite a case to show a contrast:

There are three houses in the West End, that are drained on the rule of thumb principle without proper judgment. Some months since, the agent for owners asked a plumber if he would put water closets in each house at a very low price, which he named. The plumber replied that he could not, because the drains were not right and would be condemned by the inspector, and the money offered would barely cover cost of plumbing material required, and labor, and the cost of $10 in which the waiting for inspector to come, and getting the work passed was not included. This agent showed that he had a pull, and that no inspector or official would interfere, and he undertook to secure the plumber from any blame or expense on that account, if he, the plumber, would do the job at his price. The bargain was closed, the water closets put in, the old rotten drains patched up the easiest way to make them take the stuff, and everything done openly without interference from any city official, though the inspector did visit his friend while the work was going on, in the evening, and looked through the work.

This sort of city officialism is common enough, and openly enough done; but the council will not notice it, except the parties pinched have another pull with them. Respectfully yours,

H. L. MCKINSTRY.

150 Victoria St.,
Toronto, Dec. 27th, 1897.

APPLICATION for a charter is made to the Ontario Legislature for the Smith's Falls Rideau & Southern Electric Railway Company to construct electric railways, the principal lines being within Smith's Falls, with extensions to Lombardy, Oliver's Ferry, Portland, and to Rideau Lake, Harlem, Chantry, Frankville, Toledo, Newbliss, Merrickville, Burritt's Rapids, Oxford Mills, Bishop's Mills, Easton's Corners, Irish Creek and other points within the said counties of Lanark, Leeds, and Grenville.

## TO SEE IT IS TO APPRECIATE IT.

MIKADO GOLD MINING CO., LIMITED, HEAD OFFICES, LONDON, ENG.

BIGGAR, SAMUEL & CO., MONTREAL :

DEAR SIRS,—I have just been handed a copy of your worthy paper, THE CANADIAN ENGINEER, and finding it so full of bright and useful reading, I have concluded to subscribe for it at once. So you will please find one dollar enclosed for same.

I remain, yours truly,

GEORGE W. MCKENZIE.

Rat Portage, Ont., December 17, 1897.

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

The twelfth annual meeting of this society is to be held on Tuesday, 11th inst. According to present arrangements, the meeting will be called to order at 9.30 a.m., on Tuesday, under the presidency of T. C. Keefer, C.M.G. After reading the minutes, the scrutineers will be appointed for the election of officers. Through the courtesy of the C.P.R. and the G.T.R. a special train will start at 11 o'clock for Chambly, to enable the civil engineers to view the works of the Royal Electric Co. at that place, and afterwards to enjoy an entertainment at the hands of the Electric Co. On Wednesday, at 10 o'clock a.m., the society will receive the reports of the outgoing council and address themselves to the transaction of general business.

## HENRY HOLGATE, C.E.

The prominence that is now being achieved by Canadian electricians has received another exemplification in the selection of Henry Holgate, C.E., of Montreal, as manager of the new West India Electric Co., of

HENRY HOLGATE, C.E.

Jamaica. Mr. Holgate will go to Kingston, Jamaica, about the first of February, where he will superintend the erection of about 25 miles of railway, which will probably be extended later on. Henry Holgate was born in Milton, Ont., in 1863, and served his apprenticeship with the Northern Railway of Canada. He became chief engineer of the combined Northern and North-Western Railways, which were merged into the Grand Trunk in Feb., 1888. He continued as chief engineer of this division under the Grand Trunk till 1892, when he took charge of the Central Bridge and Engineering Co., of Peterboro, as engineer for a year, during which the steel work of the new Union Station at Toronto was constructed. He came to Montreal in June, 1894, as engineer for the Royal Electric Co., and built and equipped the new factory. The directors of the Royal Electric Co. being interested in the Montreal Park and Island Railway, he was transferred to the latter company in June, 1895, where he remained in charge of operation and construction to the present time. We hope the readers of THE CANADIAN ENGINEER may hear from Mr. Holgate in his new field of operations.

## ELEVATORS: ELECTRIC VS. HYDRAULIC.

*Editor* CANADIAN ENGINEER :

SIR,—I trust you will allow me to reply to the discussion by Mr. Philip, in the December issue of THE CANADIAN ENGINEER, of the comparative merits of electric and hydraulic elevators for the city hall of Toronto. It would seem probable that Mr. Phillip has more knowledge of the operation of hydraulic than he has of electric elevators. The comparisons and statements made by him are open to serious question, and as his opinions may have weight with the readers of your valuable paper, I will state briefly my reasons for disagreeing with some of his conclusions. His divisions of first cost, safety, reliability, economy and cost of maintenance will be followed.

*Cost.*—The first cost of the electric elevator plant was $30,000, and the cost of an extra high speed engine, dynamo, incidental apparatus and piping to run such elevator would be less than $5,000—total cost of $35,000, or $10,500 less than the bid of the lowest hydraulic elevator company. If the lighting engines were merely enlarged to meet the wants of the elevators, the difference will be still larger.

*Safety.*—Again I must take exception to Mr. Philip's statements. The electric elevator is safer than the hydraulic; in addition to the mechanical safety devices of the latter, there are independent electric safety appliances, which not only prevent actual drop, but prohibit unsafe increase in speed. Of still greater importance is the condition that the tendency of the electric machine is toward safety, that is, leaks, short circuits or trouble of any kind tends to remove power and prevent motion, while in the hydraulic elevator the tendency is exactly opposite, a leak or a break meaning movement in one direction or the other. This is clearly shown in the familiar "creeping" of the hydraulic elevator due to air in the cylinders or leaks of one kind or another; yearly there are several deaths due to this cause.

Neither is there an elaborate "cycle of changes" in applying power. Current is applied to a solenoid, causing a switch to close the motor circuit, and gradually cut out resistance to the current flow. To stop the car, the auxiliary current is cut off by releasing a push button and all switches open; the car then stops, due to the nature of the worm gear, and in some cases to the use of an auxiliary brake thrown on mechanically, or by closing the motor circuit on itself, causing the car to do work and slow up. Hence there is no power "used to stop the car as well as to start and run it."

*Reliability.*—The machinery of an electric elevator does not appear complicated—it is in use in hundreds of New York buildings and receives the least possible care and attention; it is practically the simplest method of hoisting a weight, similar in some respects to the hod hoists, and consists of a drum around which the hoisting and counterweight ropes wind, the drum being driven by worm gear and electric motor. The comparative wear and tear of the two types is yet to be determined. So far electric elevators have not shown signs of wearing out, but taking the generating machinery into consideration, their life is probably less than that of hydraulic pump and cylinder. The difference is not of great moment.

*Economy.*—Here I must absolutely contradict Mr. Philip. His contention that a plant of underbalanced hydraulic elevators is more economical than a plant of overbalanced electric elevators is totally at variance with both theory and practice. He states that the pump does an average amount of work continually. This is not quite true, as the size of the pressure tank for such a condition must be abnormal, but for purposes of discussion it may be taken as a fact. But even so, the "average" work done is not the "average" work of the electric elevator plant. In the first case, as the work is the same irrespective of the load lifted, it is the average of the maximum capacities of the elevators plus one-third of the weight of the unloaded cars. In the second case the work done is merely that due to lifting the difference between the actual live load and the average load, and this is reduced by the return of current to the source of supply by the descending elevators. Figures taken from about twenty elevator plants of this type in New York city show from 1.7 to 2.5 kilowatt hours per car mile, with speeds varying from 250 to 400 feet per minute, capacities from 1,500 to 3,000 pounds and cars from 20 to 30 square feet area. The coal per kilowatt hour in one of these buildings was from 4 pounds in summer to 5⅓ pounds in winter, using simple Corliss engines direct connected to electric generators, while another building with high speed simple engines and long lines of piping required from 8 to 9 pounds. The car miles per day varied from 10 to 22, depending on the speed. Taking an average of 16 miles and 2.1-k.w. hours per car mile, the coal per car per day, in an electric plant where light is also supplied, is from 135 to 300 pounds, depending on the type of engine and heating conditions. Two hydraulic elevators operated by compound pumps, under the best conditions, in a fire insurance building in New York, use 1,000 pounds of coal per day, while with a simple pump in the same building they used 1,500 or from 500 to 750 pounds per car per day. Where expensive high duty pumps are employed the test of the American Tract Society elevators by Charles E. Emery, Ph.D., shows the coal per mile to be over 28.8 pounds, or 461 pounds for 16 car miles under test conditions. These cars were built for high speed and are not of course to be compared with the elevators in question, but it is safe to say that electric overbalanced worm-gear elevators will not and do not use over three-fifths the coal per car mile in ordinary conditions, that would be and is required for hydraulic operation, and the proportion will generally be less.

It is not necessary to have a plant of rated capacity equal to that of all the elevator motors, though Mr. Philip appears so to believe. Its rated capacity need not be more than is required for starting two elevators and running the other two (if there are four installed), as all engines and generators are built now-a-days with an excess momentary

capacity of from 50 to 100 per cent. Nor is there any short circuit of the motor on starting—as in all types of electric elevators variable resistance is inserted at starting between the generator and motor. I am sorry not to be able to coincide in my views as to storage batteries with those expressed by Mr. Philip. They seem to me to have decidedly passed the experimental stage and have become a recognized part of the modern building plant installation where economy is obtainable by their use. Whether they would be advisable for the city hall is quite another question.

It may be of interest also to state that the Edison Illuminating Company of New York does not consider "electric elevators a curse to a lighting station." They have installed one in their building as an object lesson and advocate their use as much as possible.

In conclusion I am glad to be able to agree with Mr. Philip as to the advisability of installing an isolated plant. In general, with a building as large as the city hall, a private plant will prove highly economical provided it is managed as it would be by a private corporation.

Very truly yours,

PERCIVAL ROBERT MOSES,
Consulting Electrical Engineer.

35 Nassau St., New York,
December 27th, 1897.

## STEEL RAIL HIGHWAY PROPOSED BY THE U. S. DEPARTMENT OF AGRICULTURE.

Complete designs for wagon roads, with steel trackways, have been prepared by Gen. Roy Stone, Director Office of Road Inquiry, U. S. Department of Agriculture. As many of our readers know

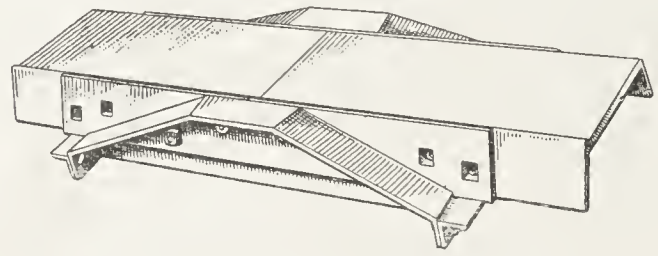


FIG 2.—PERSPECTIVE VIEW OF RAIL JOINT FOR STEEL RAIL HIGHWAY.

says the *Engineering News*, the Agricultural Department has given much attention to the subject of good roads and has organized the office of Road Inquiry to foster highway improvement and experiment with different systems of country road construction. Through the efforts of this office a model macadam road has been built at New Brunswick, N.J., and a combination macadam and dirt road, 7,000 feet long, at Geneva, N.Y. The road at Geneva has a centre of macadam 8 feet wide, with rolled dirt roadways on each side. These samples of road construction are designed to be object lessons in the economy of good material and construction for country roads.

The possible advantages of combining a steel trackway for wagons with the broken stone centre, has led the Office of Road Inquiry to investigate the subject with the idea of building an experimental road of this kind. This study has resulted in the design of the steel rail highway which is illustrated in the accompanying cuts. Fig. 1 is a cross-section of the completed road, showing the arrangement of the steel rails and stone filling, and the nature of the drainage system. Fig. 2 is a perspective view of the rail joints, and Fig. 3 is a transverse section of the same joint.

FIG. 1.—CROSS-SECTION OF STEEL RAIL HIGHWAY, DESIGNED BY THE OFFICE OF ROAD INQUIRY, U. S. DEPARTMENT OF AGRICULTURE.

As will be seen from the illustrations, the general idea is to lay two parallel lines of steel rails, supported by a broken stone filling. These rails have an inverted trough section, the top of which forms the track for the wheel, and is 8 inches wide, with a slightly raised bend on the inside edge to guide the wheel. The thickness of the top of the section which forms the track is about 7-16 inch, and the total weight of the steel and connections is about 100 tons per mile of single track. The rails will be connected transversely at intervals to prevent spreading, but there will be no cross ties, the broken stone ballast alone supporting the rail.

The construction at the joints is shown by Figs. 2 and 3. An inverted trough, Section A, forms the basis of the joint support. Over this trough are slipped the two ends of the track rails, B B, which meet in a butt-joint at the centre. To each side of the track rails are attached the remounting devices, C C, connected at the ends by the ransverse angles, D D. These three principal parts which make up the joint are firmly bolted together, as shown by the drawings. The object of the remounting device is, of course, to enable heavy wagons, which have left the rails, to be easily returned to the track by mounting the inclined shoulder at the rail joints.

Arrangements have been made with the Cambria Iron Co., of Johnstown, Pa., to roll these track rails, the arrangement to go into effect as soon as definite orders for an aggregate of one mile of road are obtained. It is estimated that the cost of rails and joints for one mile of road in the United States will be $3,500. As indicating the possible utility of steel rail highways, Mr. Stone has obtained information regarding two previous experiments with steel rails on wagon roads, and has furnished us copies of the letters from the builders, which describe the construction and operation. The first letter is from F. Melber, engineer and contractor, Standard Building, Pittsburg, Pa., and is, in substance, as follows:

"My road has been in position for about a month, and, among other interesting things, I watched the temperature of the steel when exposed to the hot afternoon sun. Every steel worker knows that steel bars lying in the yard of a bridge works, for instance, will get so warm in a few minutes that the men cannot hold them in their hands. I find that my steel stringers remain cooler than the adjacent broken stone. This, I think, is a remarkable as well as an important fact, and it goes to show that there takes place an interchange of the temperature between the inner substances and the steel, and that in this class of steel highways we do not need to provide for expansion. Altogether, I find the steel road to verify all I have said about it, even as to cost, and with regard to traction advantages I am now able to give figures. I have made twenty trials, using a gauged spring balance, and find that the average force needed to pull the iron wagon, weighing 1,550 lbs., with a 16-foot wagon-bed, is 2.5 lbs., which, reduced to a load of 2,000 lbs., means a traction force of 3 23 lbs. per ton."

The second letter is from Abel Bliss, of New Lennox, Ill., and is as follows:

"I take the liberty of giving you my experience with a steel roadway which I placed in the public highway near my home, four miles east of Jolliet, Ill. It was put down April 2, 1896, on a dirt road

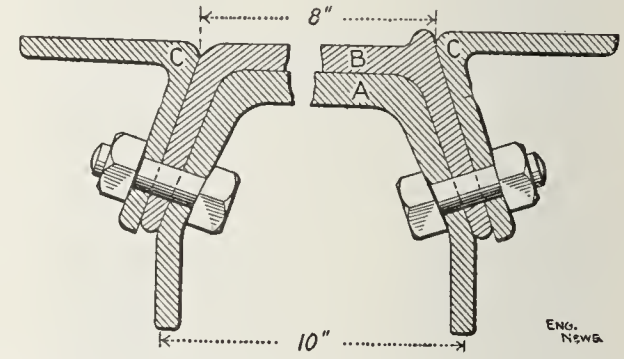



FIG. 3.—TRANSVERSE SECTION OF RAIL JOINT FOR STEEL RAIL HIGHWAY.

of typical Illinois soil, and consisted of a steel rail ¼ in. thick and 8 ins. wide, with a flange 3 ins. wide turned down on either side and a ¾-in. flange turned up on the outer edge to keep the wheels on the rails These rails were let into the ground so that the flat part rested on the earth, and were fastened together at the ends by fish plates, which are so constructed as to run the wheels onto the rails after passing a team. The earth between the rails was removed to a depth of four inches, and the space filled with gravel for a tread for the horses. These roads have been tested with all kinds of loads, including traction engines, and have retained their position very well. While the mud made the roads almost impassable here during the winter, a team could have trotted on this roadway any day with a two-ton load. About 50 tons of steel per mile will be required, having the rails ¼ in. thick, which I think is ample."

These experiments are of much interest to Canadians, especially in the neighborhood of large cities where the vehicle traffic is heavy. The added profits which every farmer would make on his produce with such roads as this would be a material factor in the development of the country.

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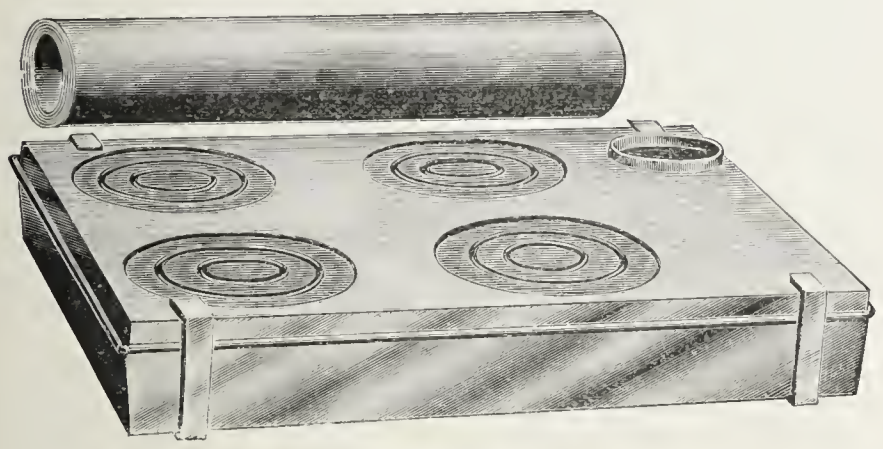
INCORPORATION has been granted to H. S. Griffin, M.D., T. J. Stewart, W. Trusdale, Hamilton, Ont.; J. Dickenson, Glanford, and W. M. German, Welland, Ont., as the Odorless Crematory Closet and General Heating Company of Hamilton, Limited, to manufacture, sell and deal in odorless crematory closets and heating furnaces. Capital, $24,000.

## TESLIN STOVES.

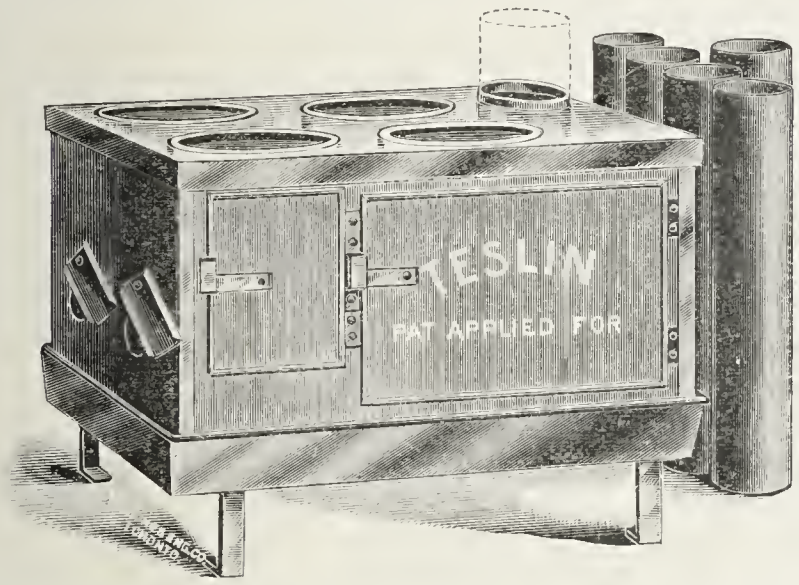
The peculiar conditions of life in the golden north are rapidly bringing into being a number of entirely new appearances to fill new wants, and also old appliances so changed as to be hardly recognizable. The peaceful blanket of our more genial climate has become the fur-lined sleeping bag of the Klondyke, and the kitchen range of the south east built into the chimney and occupying yards of space has become in the far North-West the Teslin stove, which when closed up for car-



STOVE FOLDED UP.

riage occupies a space of 28x22x4 inches, and weighs with 9 feet of pipe only 53 lbs. The following are the dimensions of the Teslin stove when set up:—Size of top, 28x22 inches; height, 13 inches: size of oven, 22x14x9 inches; size of fire-box, 22x9x13 inches; size of fire door, 6x8 inches; size of pipe collar, 5 inches; weight with pipe, 53 pounds.

The method of setting up the stove is simplicity itself. The shipping bands become feet, and by a few easy movements, much as a




cardboard box is opened for use, this stove is set up. An illustrated card giving full instruction of the process of setting up the stove is supplied to purchasers.

This stove has direct as well as indirect draft, and the arrangement of flues direct the heat around the oven for baking as in a high-priced cook stove. The simple construction of the stove renders it perfectly rigid when put together, and the heavy angled corners assist in preventing the stove from warping.

Has four 8¼ inch pot holes on top.

Five lengths of telescopic pipe (supplied with each stove) wil extend to 9½ feet. Also supplied with thimble for tent through which pipe passes.

These stoves are being placed on the market by the McClary Mfg. Co., London, Ont.

The McClary Mfg. Co. is making a specially praiseworthy effort to meet the demands of trade created by the opening up of the northern country, and is issuing a special catalogue giving details o goods adapted to the gold country.

## FIRES OF THE MONTH.

Nov. 4th—Macpherson & Co.'s Foundry, Fingal, Ont. Well insured.——Nov. 5th—Sydney Cheese Factory, J. R. Bower, Belleville, Ont., manager. Loss on building, $1,000. To be rebuilt at once.——Nov. 11th.—J. L. Pollock's saw mill and electric light plant, Drayton, Ont.——Dec. 2nd.—American Tire Co., King Street, Toronto, Loss, $6,000.——Dec. 17th.—Tate & Bateson's planing mill, Bracebridge, Ont. Loss, $2,000; no insurance.——Dec 31st.—Kingston General Hospital, Walker's wing. Damage, $10 000.——Jan. 5th.—Ottawa University, east wing. Loss, $50,000.——George W. Reed & Sons, manufacturers of sheet iron and roofing materials, Montreal, three store sheds. Loss, $12,000; cause unknown.—Lancaster Machine Works, Lancaster, Ont., shops partly destroyed on 1st January. Loss about $1,000; no insurance; will rebuild at once.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during November, 1896, 1897, and the eleven months to November, 1896-1897.

| | Month of Nov., | | Eleven months ending Nov., | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £5,734 | £5,224 | £58,897 | £63,817 |
| Pig iron | 1,732 | 2 724 | 27,936 | 9,209 |
| Bar, etc. | 1,190 | 751 | 15,239 | 8,629 |
| Railroad | 2,525 | 11 | 174,434 | 45,789 |
| Hoops, sheets, etc. | 4,044 | 6,562 | 46,721 | 77,823 |
| Galvanized sheets | 7,435 | 3,620 | 54,407 | 52,606 |
| Tin plates | 42,731 | 54 450 | 153,220 | 217,421 |
| Cast, wrought, etc., iron | 2,912 | 3,090 | 47,861 | 31,979 |
| Old (for re-manufacture) | 160 | 1,201 | 15,758 | 7,684 |
| Steel | 5,679 | 4,455 | 85,548 | 51,956 |
| Lead | 3,076 | 3,451 | 16,355 | 27,401 |
| Tin, unwrought | 6,631 | 2,386 | 20,208 | 17,369 |
| Cement | 1,735 | 1,306 | 32,766 | 19,797 |

# Mining Matters.

THE mineral exports from Nelson, B.C., during 1897, amounted to 53,971 tons, valued at $7,891,329.

A PLAN is proposed in Kingston, Ont., to open up the lead mines in Frontenac county and have the ore reduced in Kingston.

KOLIN, the clay from which porcelain is made, is said to have been discovered not far from Halifax, N.S., and of the finest quality.

D. A. JONES, Beeton, Ont., reports the find of an extensive area of quartz, rivaling the famous Hammond reef near Wahnapitae, Ont.

THE Le Roi mine has paid its regular monthly dividend of $50,000 in spite of the expense incurred in building the Northport smelter.

ASBESTOS, comparatively a new mining town near Danville, Que., claims to have a population of 1,500, and is seeking incorporation as a village.

A TRACT of sand-carrying alluvial gold is reported to have been discovered recently about ten miles from Chatham, Ont., in Raleigh township.

A FIND of platinum is said to have been made about two miles in the interior from Stevenville, St. George's Bay, Newfoundland, by Garret Dalton.

THE galena found on lot 9, con. 4, Calumet Island, Que., has assayed as high as $60 per ton in silver, with traces of gold. The outcrop is about 18 x 40.

THE Ontario Government diamond drill is working on a gold property known as "J. C., 66," a few miles east of Rat Portage, owned by N. B. Eagen, Toronto.

C. RIORDAN and J. R. Barber, Toronto, are promoting a stage line from Edmonton to Dawson, and the construction of a telegraph line. They will organize a company, it is said.

THE black gold-bearing sand which is attracting so much attention in the Saskatchewan is also found in many of the streams in British Columbia, notably in the Kootenay.

THE B.C. mine at Greenwood, B.C., has ordered a complete development plant from the Jenckes Machine Co., Sherbrooke, and work will be pushed on this property this winter.

W. AUSTIN, Cardiff township, Haliburton county, Ontario, reports a find of ore including gold and copper on his farm. Tests are said to show $16.80 in gold and $24 in copper to the ton.

THE New England Gas Company has contracted with the Dominion Coal Company for 100,000 tons of coal to be delivered annually in Boston, with the option of taking 1,500,000 tons.

THE Le Roi Mines, Rossland, B.C., are extending their pumping system, and have placed an order through the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que., for a large size special Knowles Sinking Pump.

THE Virginia Mines, at Rossland, B.C., have passed the preliminary stage and will now enter the list of shippers. An order for a large hoisting plant with boilers has been placed with the Rossland branch of the Jenckes Machine Co., Sherbrooke, and is now on the way from the East.

At Phillip's Arm, B.C., the British Columbia Gold Fields Company has established a trading post.

Jas. Conmee, M.L.A., predicts that in a year and a half there will be 1,000 stamps at work in the Rat Portage district of Ontario.

W. A. Hungerford is going to smelt the gold-bearing ores of Hastings County, it is said, on a small scale near Millbridge, Ont.

Extensive deposits of bituminous coal have been discovered at Dominion City, thirty miles from Winnipeg, at a depth of a hundred feet.

A. E. Hogue, representing a large English company, has recently examined the pay bars on the Saskatchewan River, with a view to putting in gold dredging machinery on a large scale in the spring.

The final clean-up of the Cariboo Hydraulic Mining Co. was made on Nov. 11th. The total yield of the season was $139,000. The water supply was only about half that of last year and the output was very much restricted thereby.

The Fern mines, Hall Siding, Rossland district, B.C., are lighting up the mill and yards, as well as the tunnel of the mine, by electricity, and have placed the order for machinery and apparatus with the Royal Electric Company, Montreal.

A seam of coal found near Sydney, N.S., by E. T. Mosely, will largely increase the coal area of Cape Breton. The seam is known as the Mullins seam, and is six and a half feet wide. It is 14 miles from Sydney, on the Cow Bay road.

The West Vancouver Coal Company, in which H. C. Haliday and other San Francisco capitalists are interested, will, it is said, develop their coal mines at the north end of Vancouver Island and establish a coaling station for Alaska steamers.

A nickel smelter is proposed in Toronto, to cost $500,000. If an export duty were placed on nickel matte, it is thought that capital could be secured to carry on the smelting in Ontario. R. J. Tough is promoting the enterprise in Toronto.

The Ontario Lithographic Stone and Mining Company, Limited, has received an Ontario charter; $250,000 capital. It is to be composed of A. L. Davis, H. S. Macdonald, J. W. Gray, R. M. Dennistoun and F. J. Jameson, Peterboro, Ont.

A. Drolet, manager of the Saskatchewan Gold and Platinum Mining and Dredging Company, has fitted up the Benoit & McKay dredge at Edmonton, N.W.T., at great expense, and it will be used in gold dredging and washing next season.

In the main shaft of the Foley mine, Lake of the Woods district, Ont., which is now being pushed towards the 400 foot level, there is 6½ feet of fine ore in the winze between the 200 and 300 foot levels, and four feet in the drift at the 300 foot level.

The Jenckes Machine Co., Sherbrooke, are furnishing the Canadian Rand Drill Co., Halifax branch, with one of their 20-inch Crocker Special Turbines, to be used in connection with the extensive hoisting plant being installed by the Drill Co. at the Torquay mines.

A. Mackenzie, Montreal, reports that gold is being washed successfully from the Saskatchewan River for 250 miles, the men averaging $1.50 to $4 per day each. About fifty per cent. of the gold is lost owing to its fineness. The bars may be worked over year after year, it is said, and more gold will always be found.

The officials of the Hammond Reef Gold Mining Company have announced the result of their first clean-up. From 259 tons of ore run through the ten-stamp mill five pounds (avoirdupois) of gold were caught on the plates. This is about $5 per ton, and with such a value the Hammond reef is a gigantic proposition, for the deposit is from 50 to 100 feet wide, and the ore can be mined and carried to the stock pile at less than 50 cents per ton.

The bond on the Lynn Creek properties, close to Vancouver, B.C, has been thrown up. The ore is found to contain too much zinc to be profitably worked. This is not the case, however, with copper-gold properties on Texada Island and Phillip's Arm, situated several miles north of Vancouver. Mining companies operating in these sections have shipped thousands of tons of ore as far away as Swansea and with fair results.

It is stated that the New England Gas and Coke Co. will produce from the Nova Scotia coal coke, illuminating and fuel gas, tar and ammonium sulphate—70 per cent. of coke, 10,000 feet of gas, 12½ gallons of tar and 28 pounds of ammonium sulphate to the ton of coal. One half the gas will be used in coking the coal, the rest will be available for the market and may be sold under the pipe line charter at not exceeding 65 cents per 1,000 feet.

Major Hepman, of the Fourth Royal Fusiliers, and Capt. Alleyne, of the Twelfth Lancers, have started from Edmonton for the Klondyke. The party consists of 14 men, including two doctors, besides the packers, drivers, guides, etc. They have 120 horses, a number of dog teams, etc., and expect to put in a number of tons of supplies into Dawson. After reaching Dawson they will survey the country east of the Yukon. Capt. Alleyne is also Reuter's correspondent.

The property of the old Frontenac Lead Mining Co., of Loughboro township, near Kingston, has been bought by some Toronto men who propose to organize and re-open the works under the name of the Frontenac Lead Mining and Smelting Syndicate. The late George Spotswood always contended that, under good management, which the old company never had, this lead mine would pay well, and the new company proposes to put this to the test by putting in a drift below the present workings.

The construction of the new reverberatory and calcining furnaces at the Hall Mines' smelter is being pushed, and it is expected that they will be completed in about two months. The large blast furnace made a run recently which broke the record, turning out 26 tons of matte in 24 hours. Everything is working smoothly and the ore treated continues to be of a very high quality. The management is smelting lead ores from the Slocan in the old 130-ton furnace, which has been converted into a lead furnace.

The Canadian Copper Company, an Ohio concern, and the Anglo-American Iron Company, which control the output of the nickel and copper mines around Sudbury, have special charters domiciling them in Canada on certain conditions, one of which was the establishment of smelting works for the reduction of the ores. It is claimed that in breach of that they have taken their ore to the United States and had it smelted there, and that they have spent in wages and railway freights about $1,250,000 a year in this way outside of Canada. B. B. Osler, Q.C., of Toronto has filed in the Department of Justice, at Ottawa, a petition to the Attorney-General of Canada for leave to bring an action against these companies to revoke their charters.

The Dominion Coal Co., in reply to the criticism regarding the closing of its two collieries at Port Morien and Victoria, states that a new shaft will be opened in a more central part of the coal producing district of Cape Breton. It is stated that the new shaft and equipment will cost $250,000, and two new washing plants will be erected at a cost of $50,000 each. Later on it is intended to build a pocket at Louisburg large enough to hold a ship's cargo of 6,000 tons, with apparatus enabling this quantity to be discharged into a steamer in six hours. For this purpose a new pier will be erected at Louisburg, the outlay at this port being about $250,000. Near Sydney the company is now building a pier to cost $50,000. Altogether the company asserts that it will spend $700,000 in the next two years.

The shipments of ore from Kaslo, B.C., are an indication of the value of the Sandon silver mines. During the month of October, the shipments amounted to 8,450,000 pounds, valued at nearly $400,000. Of this 2,784,110 pounds were lead, and 397,977 ounces silver. The record for the same month in 1895 gave 735,000 pounds of ore, and for 1896 the figures were 1,286,993. The shippers of ore in the Slocan district number over 40, and the mines that are paying dividends number 25. The records show 14 shipping mines for 1895, 39 for 1896 and 53 for 1897, though some of the shippers are not shipping regularly. Returns of ore shipped from the Slocan and Ainsworth mining district, taken from the custom house clearances for the nine months ending September 30th, 1897, show 47,435,000 pounds, valued at $1,853,000, as compared with 23,344,000 pounds, valued at $1,114,000, for the whole twelve months of 1896.

The Calumet galena mines, though owned by men in the neighborhood, is now being worked by a Belgian. The product is a conglomerate of lead and zinc ore containing from seven to twelve per cent. of silver; but about the total wealth of the mine it is at present impossible to form an opinion. The property on Chats Island is that in which Jas. Robertson, of Montreal, is interested. There is an immense deposit of pure galena without any admixture of zinc. It is easily obtained and requires but a small outlay of capital. A recent find has given the proprietors a new impulse, and it is very probable that the mine will be opened up at an early date. Mr. Tough, a well-known owner of mining property in the Sudbury district, also possesses a mine on this same island, containing a deposit of much the same character as that in the aforementioned mine. The extent of this deposit cannot be known ill next spring, when the snow has disappeared. The operation of extracting the valuable metal from this ore has been somewhat difficult hitherto, but a new method has recently been discovered in Germany, which will be adopted in the cases of these mines.

A. J. G. Swinney, manager of the Canadian Gold Fields, Limited, Deloro, Ont., told the Toronto *World* recently, that the syndicate has already expended $500,000 in securing control of several square miles of territory, in opening up the same, sinking shafts, installing machinery, etc. With this as a beginning, the company will not cease their outlay

until the mines have attained a producing capacity of $5,000 or $6,000 per day. The underground work done on the property at present consists of two shafts, located a mile or so east of the reduction plant at Marmora Station, on the Central Ontario Railway, but four additional shafts are forthwith to be sunk—two near the old shafts, and the other two a mile to the north and a mile to the south thereof respectively. In order to carry on this work expeditiously, Mr. Swinney has arranged for the immediate installation of a twenty-drill air compressor. And when, with this extensive mining plant, a big ore reserve has been obtained, the capacity of the bromo-cyanogen mill will be increased, so that it will treat 400 tons per diem. Mr. Swinney says that the mispickel averages $15 per ton in gold, and that the new process saves 85 per cent., or over $12 of this. This means, as stated above, that the enlarged mill should turn out between $5,000 and $6,000 in bullion each day. It is also learned that the same money that is invested at Deloro is behind the re-opening of the Belmont gold mines, located nine miles to the northwest of Marmora Village, and formerly owned by A. W. Carscallen, M.P. The Belmont ore is concentrating, and a stamp mill is being erected upon the property.

## Electric Flashes.

WALTER MCFARLANE is putting the electric light into his factory at St. Mary's, Ont.

THE Carleton Place council threw out the by-law to grant a bonus to the Lanark County Electric Railway Co.

THE Canadian General Electric Company has installed an isolated plant for A. & J. Clarke, Bullocks Corners, Ont.

THE Cardinal, Ont., starch works is putting in an electric light plant of sufficient power to furnish the works and the town with light.

ENGINEER CHURCHILL, of the S.S. "Iceland," is now in charge of the electric light station, St. John's, Nfld., in place of J. Hepson, resigned.

THE Pontiac Telephone Co. is putting telephones in each of the stations along the line of the P.P.J. Railway from Quyon, Que., westwards.

THE town council of Parrsboro, N.S., has been authorized to spend $8,000 in equipping an electric light plant, to be the property of the municipality.

ST. THOMAS, ONT., has voted to guarantee $50,000 of the bonds of the new electric street railway company, and to pay the first year's interest on them.

THE Windsor Plaster Co., Windsor, N.S., is lighting its works by electricity, and has given the order for the electrical equipment to the Royal Electric Co.

THE Toronto Electric Motor Co. is now running night and day, and notwithstanding recent enlargement of the works is scarcely able to keep up with orders.

THE Dominion Paper Mills, Kingsey Falls, Que., are installing an electric lighting plant in their new mills, and have placed the contract with the Royal Electric Co.

IT is proposed to extend the Belleville, Ont., Street Railway to Trenton and Tweed, using rails sufficiently heavy to allow of the C.P.R.'s hauling freight over the line.

THE Bell Telephone Co. will shortly put up for its Quebec headquarters a new office building, on the corner of St. John and St. Angele streets, Quebec, at a cost of $15,000.

THE St. Jerome Power and Electric Light Co. has had such success in canvassing for lights that it has changed its order from 1,000 light "S.K.C." machine to one of 1,500 lights capacity.

THE St. Lawrence Power Company is applying to the Quebec Legislature for incorporation, for dealing in water, electric, steam and any other power for lighting, heating and manufacturing.

C. E. SHEDRICK, who has assumed control of the Whitney Electrical Instrument Co., Sherbrooke, Que., has on hand a stock of measuring instruments, laboratory apparatus, X-ray apparatus, etc.

THE British Columbia Iron Works Company, Vancouver, B.C., have placed an order for a 10-kilowatt, direct connected, steel frame, incandescent lighting generator with the Canadian General Electric Company.

THE expenses of the municipal electric light plant of Lachine, Que., in 1897 amounted to $3,282, the lighting being 850 electric lights and 43 arc lamps for the entire town. The receipts for the same year mounted to $3,066.

THE Canadian General Electrical Co. has recently installed a 250-light plant in the premises of the Northey Manufacturing Co., Toronto.

THE Seine River, Foley and Fort Frances Railway Company, is applying for an Ontario charter to build a line from Bonheur on the C.P.R., to Sawbill Lake, Fort Frances, etc., and to dispose of surplus electricity for power and other purposes.

THE Shipton Electric Co., Danville, Que., has decided to proceed with the extension of the power plant this winter, and has made a contract with the Jenckes Machine Co., Sherbrooke, for a Crocker turbine, horizontally set, with penstock and draft tube complete.

THE officers of the Sherbrooke, Que., Street Railway Co. are: President and chief engineer, John W. Burke; directors, Percival W. Clements, Rutland, Vt.; Edgar Harding, Boston; Walter Blue, Wm. Morris, Sherbrooke; superintendent L. E. Whitehead; secretary, F. J. Griffith.

BOBCAYGEON, ONT., has a scheme to secure electric railway communication with Peterboro. The proposal is to build a line to Scott's mills, some twelve miles east, then south to Buckhorn, and on to Peterboro. It has been estimated that the line can be built for less than $200,000.

THE Edmonton Electric Light Co., of Edmonton, N.W.T., is improving and extending the plant. The new electrical equipment bought by them from the Royal Electric Co., consists of one 75 K.W. "S.K.C." two-phase generator, complete, with exciter and switchboard, as well as the necessary material for the other changes.

THE Canadian General Electric Company has recently closed a contract with the Bushnell Oil Company, Sarnia, for a 25-kilowatt direct connected, steel frame, incandescent lighting generator, coupled to an "Ideal" engine. This installation will embody all the latest improvements in direct connected practice, which the Bushnell Company, from its connection with the Standard Oil Company of the United States, has learned to value through their experience there.

THE turning on the power and light in connection with the new municipal electrical lighting plant, at Magog, Que., was made the occasion of a reception given by the Mayor and Councilors in the Opera House. The hall was brilliantly lighted by incandescent lamps, and the whole town turned out. Speeches were made by Mayor Bessette and other councilors and a very pleasant evening was spent, Magog is one of the first towns in the Eastern Townships to own and operate its own lighting plant. The power is obtained from the Magog River, a little below the cotton mills. The water wheel plant of the Crocker special type was furnished by the Jenckes Machine Co., Sherbrooke, Que.

THE Canadian General Electric Company is supplying a 1,000 light direct connected, incandescent lighting plant for the Gutta Percha and Rubber Manufacturing Co. This installation will be, when finished, one of the most complete in the country. The machine is of the steel frame, ventilated, armature type, direct connected to an 'Ideal" engine, running at the slow speed of 280 revolutions per minute. The great saving in space, durability and high efficiency obtained by the use of these direct connected units has led to their adoption as the standard machine where it is desired to obtain the best and most economical conditions in operating an isolated incandescent lighting plant.

THE Packard Electric Company, Limited, St. Catharines, Ont., announces that it has recently imported from England a sand blast frosting machine, which it is claimed produces frosted lamps far superior to those which have been previously placed upon the market. The effect produced by frosted lamps is appreciated by everyone, but their use in the past has been exceedingly limited, both on account of the inferior class of work in this line, as well as the price charged. The company is also in a position to do any style of fancy frosting, bringing out letters, monograms and any desired design, upon lamps to be used for decorative work. The fine frosting, which this up-to-date machine produces absorbs much less of the light than any ordinary frosted lamp.

THE plant and franchise of the Temple Electric Co., Montreal, have been acquired by the Standard Light and Power Co. The Lachine Rapids Hydraulic and Land Co. have made a contract with this company to supply it with current from the Lachine Rapids and the steam plant will be sold. The Lachine Co. has also closed a contract with the Imperial Electric Co., formerly the St. Jean Baptist Electric Co., to supply it with current, replacing the present steam plant. Although the thermometer has been down below zero this winter, no difficulty has been encountered with frazil ice.

E. RUTHERFORD, electric supplies, Peterboro, Ont., has assigned to R. R. Hall.

M. S. CORNELL, Stanbridge East, Que., is planning to install a lighting plant next spring.

G. C. HINTON & Co., Victoria, B C., are wiring the Jubilee Hospital there, and supplying the fixtures.

JACOB UNLEY has installed an electric lighting plant in New Hamburg, Ont., which is proving satisfactory.

NEIL & KENT, Granby, Que., have placed the contract for lighting their factory with Allen Taylor & Co., Waterloo, Que.

THE C.P.R. Telegraph Company has built a line from New Denver to Nelson *via* Slocan City. This line not only increases the capacity of the Kootenay systems but gives an alternating wire to the main line *via* Revelstoke.

THE Richmond Light and Power Co., Richmond, Que., is adding to its electric lighting equipment, and has placed with the Royal Electric Co., Montreal, an order for a 75 K.W. "S.K.C." generator and switchboard complete.

A. H. ST. GERMAIN, North Toronto, is about to organize an autocar service between York Mills and Toronto. He has ordered three electric busses, each capable of carrying 30 passengers, from an English firm and they will be delivered in Toronto before next spring.

A COMPANY has been formed to build an electric railway between St. Catharines and Port Dalhousie. H. D. Symmes, manager of the St. Catharines and Thorold Railway, has let the contract for the cars required for the new line, and will shortly let contracts for four miles of rails, 9,500 ties and 300 poles, wire and bonding, also a 100 k.w. railway generator and several 35-h p. motors.

THE Stevens Manufacturing Co., of London, Ont., has put in dynamos for a 500-light plant for Walter Steward, Lucknow, Ont., who will supply the village with electric light. The same company has put in a 300-light plant for the village of Glencoe. The wiring in connection with these two contracts has been done by the Rogers Electric Co., of London.

THE proposed Smith's Falls Rideau and Southern Electric Railway is to be in the town of Smith's Falls, Ont., with extensions to Lombardy, Oliver's Ferry, Portland, and to Rideau Lake, Harlem, Chantry, Frankville, Toledo, Newbliss, Merrickville, Burritt's Rapids, Oxford Mills, Bishop's Mills, Easton's Corners, Irish Creek and other points within the counties of Leeds. Lanark and Grenville.

THE Toronto and York Radial Railway Company applies to the Ontario Legislature for a charter to amalgamate the Toronto and Scarborough Electric Railway, Light and Power Company, Limited; the Toronto Belt Line Railway Company; the Metropolitan Street Railway Company of Toronto; the Toronto and Mimico Electric Railway and Light Company; the Toronto Suburban Street Railway Company, Limited.

THOS. L. KAY, the well known electrician, formerly of the Kay Electrical Manufacturing Co., has recently severed connection with that firm, and is now with the Canada Electric Motor Co., who have recently started in Hamilton with good prospects. The following are some of the plants just finished:—John Duff & Son, grocers and butchers, 208 and 210 York Street, Hamilton, a 150-light dynamo with 150 incandescent and one arc light, the whole work done by the Canada Electric Motor Co. A 100-light dynamo with a number of incandescent lights installed at the waterworks of Hamilton. A motor for the St. Catharines Electric Railway. The repair of a 250-horse power generator; 8-h.p. motor for Leitch & Turnbull, elevator; motor for Bradt, grocer; a 10-light dynamo for Lees & Son, bakers, and various others. Mr. Kay is one of the pioneers in the electric business in Canada. He started in a small way on the corner of Bay and Market streets, Hamilton, in 1880, and has been connected with the business ever since. Mr. Kay was the first to exhibit a successful light in Hamilton. There were very few electric lights in Canada when he introduced his light, and now there is hardly a city or town in the Dominion where there is not a machine of his design in use. Mr. Kay has devoted the whole of his attention to electricity, the building of electric machines of all kinds. alternating or direct current dynamos, motors, transformers and all kinds of electric work. Any work entrusted to the Canada Electric Co. will receive Mr. Kay's careful attention. The works of the new company are at 32 and 34 Bay Street North. Mr. Kay has associated with him T. O. Apps, who has had considerable experience in the business department of electrical work. Mr. Apps is secretary-treasurer of the Canada Electric Motor Co.

# Railway Matters.

THE G.T.R. recently brought a car load of fruit from Portland, Me., to Hamilton, Ont., 670 miles in 32 hours.

ON the eastern section of the Grand Trunk the old eight-wheel freight engines are being done away with and replaced by ten-wheel engines.

THE Signal Engineer Hodgson, of the G.T.R. engineering department, has completed the work of putting in at Woodstock, Ont., interlocking switches.

IT is the intention of the Canadian Pacific Railway Co. to keep the shops running in Winnipeg all winter, fitting up locomotives and cars for the spring traffic.

A BONUS of $75,000 to the Ottawa and New York Railway, to establish workshops in Ottawa, has been adopted by the property owners by a majority of 928.

SINCE the first of January the Intercolonial Railway, the Prince Edward Island Railway, and the leased lines, are known as the Canadian Government railway system.

THE Quebec Government has refused the $250,000 promised to the Victoria Bridge by the late Government, and also the $250,000 promised the Drummond County Railway.

THE I.C.R. management expect to reduce the number of engines between Halifax and Montreal by half, through the new and improved type recently adopted. The number now in use is twenty.

THE Grand Trunk has received 500 freight cars of 60,000 pounds capacity each, built by the Michigan Car Company, Detroit. Another lot of 500 freight cars are being built in the Canadian shops of the system.

THOS. TOMPKIN, Brockville, has been awarded the contract for the erection of a station for the C.P.R. at Vancouver, B.C., also for a number of other buildings for the company in different parts of that Province.

PUBLIC meetings have been held in Toronto, and resolutions passed favoring the building of a railway to James Bay. A great deal was said about aid from the Dominion and Ontario Governments and the Toronto city council, but none of the promoters said what amount of money they were prepared to invest in what would undoubtedly prove a most valuable addition to the Canadian railway system.

THE Nova Scotia Midland Railway Company, composed of Wm Strachan, Jno. Beattie, P. Lyal, D. L. Lockerby, Wm. Mackay, S. H. Holmes, and B. F. Pearson, has signed an agreement with both the Dominion and Nova Scotia Governments, each of which subsidize the road to the extent of $3,200 per mile, for the construction of a railway from Windsor, N.S., to Truro. W. G. Reid, Montreal, has the contract to build the Midland, which is 50 miles in length.

APPLICATION will be made at the next session of Parliament by the Hudson Bay and Pacific Railway Co. for an act of amendment to their charter empowering them to abandon that portion of their projected line extending from Prince Albert to Calgary, and to establish in its stead a branch between Prince Albert and Edmonton, and also to lay out a line from Edmonton to a point on the eastern boundary of the Province of British Columbia.

ONE issue of the *Canada Gazette* contained the following applications for railway schemes in the Yukon and Kootenay countries. The Klondyke Exploration Company of London, Ont., asks for letters patent authorizing them to acquire lands and facilities for mining, smelting and transportation purposes. The applicants are: J. M. McIntyre, St. Thomas; J. A. Moody, London; D. A. McIntyre, St. Thomas; R. H. Marshall, London, and G. M. Fox, London. Molyneau St. John gives notice of application to Parliament for the incorporation of a company to construct a tramway between the head of Lake Lindemann and the mouth of the Lewis River, to avoid the White Horse Rapids and other obstructions to navigation. Lafleur & Macdougall give notice for a company to operate a railway from Fort Selkirk to a point on the international boundary, on a route towards the mouth of the Stickeen River by way of the Hootalinqua River and Teslin Lake, with branch lines. A company applies for a charter through Geoffrion, Dorion & Allan, of Montreal, to build a railway from a point on the Lewis River, between Five Fingers and Fort Selkirk and a point on the international boundary, on a route towards the mouth of the Lynn Canal, with branch lines. Notice is also given of application for an act to incorporate a company to build a railway from the head of the Lynn Canal northward along Dalton's Trail to Fort Selkirk, N.W.T.

# Marine News.

THE contract for masonry on the Soulanges Canal, recently taken rom A. Stewart, has been re-let to Ryan & Macdonald.

WOODEN ship-building is being carried on with renewed vigor in Newfoundland this season. Most of these schooners are for the Labrador trade.

THERE is a rumor of a new Canadian freight line between Halifax and Liverpool, but the parties whose names are mentioned, are reticent about giving information.

JOHN & MICHAEL O'LEARY have completed their contract on the Soulanges Canal, which covered section No. 3, the approximate value of the work being $230,000.

H. E. GIDLEY, Penetanguishene, Ont., is building a fine steam yacht for W. A. Gorby, Marion, Ind. She will be fitted with compound engines and a water tube boiler.

THE Albion Iron Works Co., Victoria, B.C., is fully employed building river steamers for the Yukon and Stickeen Rivers for the C.P.R., the Hudson's Bay Co., and others.

THE Donnelly Wrecking Company, which made arrangements to release the stranded steamer "Rosedale" for $17,000, has succeeded in placing the steamer in the dry dock at Kingston.

THE Klondyke Trading and Transportation Corporation, which Sir Charles Tupper organized, has purchased the first-class steamer "Amur" from Labaun. She will run to Stickeen and to St. Michael's.

J. H. MOIR, of New Westminster, B.C., has been awarded the contract for the construction of two stern-wheel steamers for the Stickeen River route by the Hudson's Bay Company. The steamers will cost about $20,000 each.

THE Hon. J. R. Thibaudeau, the Hon. A. A. Thibaudeau, C. N. Armstrong, E. A. D. Morgan, Montreal; R. Audette, Quebec; and L. H. De Friese, London, Eng., have applied for letters patent as the Atlas Steamship Company. The chief place of business will be Montreal, and its capital $500,000.

CAPT. C. H. MCLEOD, Pictou, N.S., is now at Portsmouth, New Hampshire, where a party of Klondykers is being fitted out. The captain has secured an engagement to take a vessel round Cape Horn, or through Magellan Straits, and the party expects to be at the mouth of the River Yukon when navigation opens.

THE London manager of the Canadian Pacific Railroad confirms the report that the company has bought from the Union Steamship Line the steamers "Tartar" and "Athenian," formerly the favorite liners in the South African mail service, and will establish a regular freight and passenger communication between Vancouver and Fort Wrangel, at the mouth of the Stickeen River. Each will do the trip within three days.

A CHARTER has been granted to L. L. Beer, C. Palmer, G. J. Rogers, J. Pitblado, W. W. Beer, T. W. Dodd, A. Kennedy, W. Welsh, R. Fraser, F. L. Haszard, Charlottetown, P.E.I., to acquire by purchase, lease or otherwise, and to build steamships and other vessels, docks, wharves and other terminal facilities, and to carry on the business of a transportation company for transport of passengers and freight, as the Inland Navigation Company, Limited, with a capital of $13,200.

FOLGER BROS., Kingston, Ont., have bought the steamer "Shrewsbury" and will put her on from Clayton to Montreal, along with the "America" during the coming season. The "Shrewsbury" was built at Bath, Maine, at a cost of over $80,000 about a couple of years ago, and has been in commission only a short part of the time since. Her dimensions are 161 feet 6 inches length of keel, 26 feet 6 inches beam, 7 feet 3 inches depth of hold and 47 feet 9 inches over guards. She has compound engines of the inclined type, 25 x 46 inches, six-feet stroke. There are two boilers, Worthington condenser, steam steering gear, improved feathering paddles.

AT a meeting of the board of directors of the Richelieu & Ontario Navigation Company, it was determined to call the new steamers to be built in Toronto the "Toronto" and the "Kingston." It was resolved to make repairs to the steamer "Laprairie." She will receive new feathering wheels. Other improvements to the western fleet are now in contemplation. The details in connection with the outfit of the company's steamers generally, the improvement of their appearance, and the interior of the saloons, especially on the "Quebec," and new conveniences for state-rooms, were also resolved on. Alterations to the steamer "Berthier" will also be gone on with, with a view of increasing her speed and carrying capacity.

THE C.P.R has completed arrangements in Toronto, for the construction of three light draught stern-wheel steamers to ply in Alaskan waters, in conjunction with the two ocean steamers which they have purchased in Scotland. These vessels will be constructed in Toronto, the contracts having been let to the Bertram Engine Works Co. for two boats, and the Polson Co. for one boat. The plans have all been prepared, and work will be commenced at once, as it is intended they shall be ready for the opening of navigation. The boats are of wood, plated with steel, and will have a length of 156 feet, with a beam of 30 feet. They will be put together in the Toronto yards and will then be taken apart and the parts shipped to Vancouver. The two ocean steamers' run will be from Vancouver to Wrangel, at which point passengers will be transferred to the new light-draught boats, which will ply on the Stickeen River. Captain Troop, who is superintendent of a line of steamers plying in the Kootenay district, has been, it is understood, given the position of superintendent of the new line of C.P.R. steamers in Alaska.

# Personal.

W. W. Ogilvie has presented another $1,000 to the Winnipeg general hospital.

MANAGER SKIDMORE, of the Waterworks Company, Berlin, Ont., will leave shortly for the United States.

A. MCDONALD, contractor, Woodstock, Ont., was killed by a G.T.R. train at a level crossing in Woodstock, Dec. 15th.

MORTON WEBB, mining engineer, son of F. R. Webb, Petrolea, Ont., returned from Colorado for the Christmas vacation.

JAMES LAMOND, formerly with E. Leonard & Sons, London Ont,, has accepted a position with the Goldie McCulloch Co., Galt.

R. MAITLAND ROY, Peterboro, Ont., who has been connected with the engineering staff of the Central Bridge Co. for a number of years, has accepted a responsible position with the Hamilton Bridge Co., and will remove to the ambitious city.

WHILE visiting at the house of a friend in Toronto, Sylvester Neelon, well known as a member of the firm of Elliott & Neelon, contractors for the masonry work at the new municipal buildings, died suddenly of apoplexy. The body was taken to St. Catharines for burial. He was 74 years of age, had lived in St. Catharines for half a century, and was prominently engaged in extensive milling and timber business. He built the large Empire flour mills, which are now occupied by the Packard Electric Co., St. Catharines. He represented the county in the Ontario Legislature. He was president, up to the time of his death, of the Niagara Central Railway Company, and it was through his work that the road was built.

HURD PETERS, engineer in charge of the harbor improvements at St. John, N.B., was the recipient of a pleasant attention from the men employed on the works. The men employed about the works assembled in the warehouse and D. C. Clark, in their behalf, read an address to Mr. Peters, expressive of appreciation of his services, his constancy in attending his duty, his zealous care in the city's interests, and his pleasing manner, which had been an encouragement to them. Mention was made that the relations between Mr. Peters and the men had always been of the most pleasing character. The address was signed on behalf of the workmen by D. C. Clark, foreman of wharf construction; Thomas Thompson, foreman of warehouse construction; D. W. Clark, superintendent of pile driving; James McMurray, captain of dredge "Cape Breton"; John W. Dickinson, captain of dredge "Freeport"; James Fennell, captain of dredge "H. F. Bothfeld"; Frank S Henrion, diver. Accompanying it was a gold headed ebony cane, suitably inscribed, also a silver ice pitcher. Thomas Thompson made the presentation of the pitcher and D. W. Clark the cane. Mr. Peters said it was usual on occasions of this kind to say it is unexpected and surprising. All can bear me out, he said, that this is utterly and absolutely true in this instance. For forty odd years I have been connected with the city's work, and sometimes have done good work, and always have had pleasant and cordial relations with the men, but never till now have they given expression to it, and that I appreciate it you must know. My schoolboy holidays were spent in Carleton from the time I was ten years of age, and I have had a great deal to do with Carleton from the time I put in the waterworks, and have always found the workmen competent and efficient. A report I prepared some time ago for presentation to the harbor improvements committee gives expression to my opinion of the excellent way in which you have worked. It gives all due credit to the foremen, but shows that the completion of the work is due to the men, who throughout have shown a friendly spirit and have worked with vigor and energy. Never was more work done, and better done, in five months; and every man who

used an axe or an adze has earnestly done his share in bringing it to a successful conclusion. Mr. Peters concluded by again thanking the men and assuring them of his good wishes, and declaring if the city undertook, as he hoped it would, the completion of the work on the other side of the slip, that they were the men for it.

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—Every manufacturer of first quality paving brick is directly interested in establishing a uniform method of testing paving brick, as a matter of self preservation, for uniform tests mean impartial comparison. Hence, it behooves paving brick manufacturers, or municipal officers and city engineers to have a copy of the Report of the Paving, Brick Commission. It is a neat book of 110 pages, containing all of the comparative tables and charts compiled for the National Brick Manufacturers' Association of the U. S. by a special Commission, under the direction of Prof Edward Orton, Jr. The universal adoption of the methods recommended by the Commission will redound to the credit of paving brick and to the profit of the manufacturers. Copies may be had through THE CANADIAN ENGINEER at $1.00 per copy.

—We have received the fifty-first volume of the Canadian Almanac from the publishers, Copp, Clark Co. Limited, Toronto. Besides being a directory of clergy, militia, Government officials, members of Parliament, county and municipal officers, schools and colleges, barristers and solicitors, and other public men, it is a compendium of information of all kinds relating to Canada. Some of the more prominent departments are; Short History of Canada, Tariff of Customs Forms of Government throughout the world, Post Office Gazeteer Masonic Lodges, Miscellaneous Societies, Historical Diary, Life Insurance. Some new features for 1898 are: Short accounts of the British Army and the British Navy, with illustrations; also articles on the English Government, and Extraditions and Pardons. Besides the above, with every copy of the Canadian Almanac for 1898 is presented a map of North America, beautifully engraved and printed in five colors. The price, 25 cents.

—The annual meeting of the Atlantic and Lake Superior Railway was held in Montreal, on the 3rd inst. The President in his report said the arrangement made by Mr. Armstrong with the London syndicate was, for the present, a confidential document; but under the agreement, the company had constructed 20 miles of road between Caplin and New Carlisle, and trains are running on that section. Two parties of engineers are about to start locating the line between Paspebiac and Gaspe. The line as far as Port Daniel, 25 miles long, is an easy section, but between that point and Gaspe, several surveys will have to be made before the best route can be selected. The company has also done considerable work between Yamaska and Levis on the Great Eastern Division, grading being nearly finished between the St. Francis and Nicolet Rivers. Traffic will be open between Nicolet and St. Gregoire, and to St. Angele, opposite Three Rivers, this month. The directors have bought from the C.P.R. the section of the South Eastern between Sorel and Yamaska, including the Yamaska river bridge. This makes a connection with the South Shore Road, and the C.P.R. and United Counties Railway will pay for running rights over it. The section between Yamaska and Levis will probably be finished before the close of 1898, and wharves, warehouses, etc., will be constructed at Paspebiac, and the Government will be asked to assist in building this port. The section between Riviere du Loup and Metapedia will be 115 miles, or 60 miles shorter than the Intercolonial between the same points. This country is as yet unsettled, but is well timbered and watered, and the soil is rich. The following officers were elected: President, Hon. J. R. Thibaudeau; first vice-president, Hon. Wm. Owens; second vice-president, Hon. V. W. Larue; secretary, E. N. Armstrong; general manager, C. N. Armstrong. The three representatives of the Quebec Government, Hon. V. W. Larue, Jas. Baker, and Chas. Chaput, were continued in office.

# Industrial Notes.

F. J. HENDERSON is building a butter factory at Gananoque, Ont.

THE town of Goderich is applying to the Ontario Legislature for authority to spend $50,000 in building a grain elevator.

THE E. B. Eddy Co., Hull, Que., has, it is said, entered the Diamond Match combination, and will greatly enlarge its premises as a consequence.

THE city of Hull, Que., has ordered 500 tons of pipe from the St. Lawrence Foundry Co., Toronto. The pipe will be in sizes running from 3 to 15 inches.

THE Victoria, B.C., Metallurgical Works Co., Limited, has been incorporated.

H. C. MCBRIDE, architect, London, Ont., won the competition by his plan of the Jubilee Hospital for that town.

THE Auburn Woolen Mills, Peterborough, are putting in an improved system of fire protection, and have ordered a number of hydrants, check and gate valves, from the St. Lawrence Foundry Co., Toronto.

THE Hamilton and Toronto Sewer Pipe Co. is now building an up-to-date factory, which will enable them to maintain in future the excellence of their product in the past; in the meantime, stocks on hand are sufficient for the trade till the factory is completed.

ACETYLENE gas is said to be making headway in many parts of Manitoba, particularly at Morden, where the apparatus is manufactured. The underwriters' regulations for the use of acetylene are, our readers will remember, much less severe in Manitoba than in Ontario.

THE E. B. Eddy Company, Hull, Que., is adding eight new 5x14 feet tubular boilers to the battery of 24 boilers. The new boilers are to be used as auxiliary to the present water and steam power plant, and will drive some of the small paper and printing machines, and the pumps and engines.

THE Verity Plow Company has decided to remain in Brantford. The company wants $15,000 for the old buildings, exemption from taxes and free water, an 8-inch main being necessary for the new works. The building they will erect is to cost not less than $40,000. The company will give $10,000 guarantee that they will remain in Brantford for five years, and a $5,000 guarantee for five years longer.

THE property of the Guelph Norway Iron and Steel Company was sold a short time ago for $9,700 to John Taylor, formerly employed by the company. Forty-eight thousand dollars was invested in the enterprise. Work on the building was commenced in May, 1895, operations began in January, 1896, and the mill ran off and on until May, 1897, when it was closed. The stockholders will lose everything, it is said, and the creditors get about eighty-five cents on the dollar.

A FLOOD was caused at Norwood, Ont., Dec. 15th, when the dam of the pond used to run Jas. Cummings' woolen mills gave way, and coming in contact with Nield's foundry, owned by J. L. Squier, it completely demolished it. Part of the stream entered the woolen mills and did considerable damage. The water carried away three bridges, and hundreds of cords of wood owned by J. Finlay & Son, Squier Bros., and James Cummings.

F. E. DUCKHAM, engineer of the Millwall Docks, London, England, was in Kingston, Ont., recently, with the view of getting the Canadian Engine and Locomotive Works for the building of two Duckham pneumatic grain elevators for the Montreal Pneumatic Grain Elevator Company. The pneumatic elevator, in addition to pumping grain, can transmit it horizontally 700 or 800 feet along a pipe to the warehouse and elevate it to a height of 80 feet to various bins. In loading vessels it can, it is said, handle grain at the rate of 180 tons per hour, screening, grading and weighing it in the transmission.

THE organization meeting of the Jacques Cartier Pulp Co. was held December 11th, 1897, when E. Golf Penny, Wm. Law, and W. Currie were elected trustees and Geo. McDonald, secretary, to carry on the business till incorporation is secured. This company will buy the pulp mill at St. Jeanne de Neuville, which has been sold to them by E. Bradley, C.E., for the owner, James Reid, of Quebec. The company proposes to put in new machinery to double the output. American and German experts have viewed this water-power and pronounce it unique, as nature has done most of the engineering work by a natural tunnel underground, about 600 feet long, producing a fall of 65 feet. The future capacity of the mill will be ten tons per day, mechanical.

THE terms of the agreement entered into between Abbott & Co., Montreal, and the city of Kingston, Ont., relative to the removal of the works to that city, have been made public. The company will be given a free site and a bonus of $50,000; the plant and machinery to be valued at $250,000 by a board of valuators, who will make their award ten days after the works are in running order. Abbott & Co. agree to carry on the business twenty-five years, and employ during the first year 125 to 150 hands. The pay-roll is to range from $40,000 to $50,000. Before the end of the second year the company will employ from 175 to 200 men, their pay-roll to range from $50,000 to $60,000. The city will have the first lien on the buildings and plant to the extent of the bonus for the period of twenty years, and the works must be operated 275 days in each year.

PARRSBORO', N.S., will spend $4,000 on firehall equipment.

A PEQUEGNAT'S bicycle factory, Berlin, Ont., is being equipped.

JAS. CAMERON, Fallbrook, Ont., is starting a sawmill at Harper.

A NEW market building is proposed for Brantford, Ont., to cost $4,000.

THE city of Ottawa purposes to spend $70,000 on buildings in Lansdowne Park.

E. R. SIMPSON & Co., engineers and machinists have begun business in Berlin, Ont.

WINNIPEG will spend $700,000 on a system of water works, to be supplied from artesian wells.

THE Welland Vale Bicycle Co., St. Catharines, Ont., is manufacturing a chainless bicycle for next season.

THE Rathbun Company, Deseronto, Ont., has been shipping carloads of doors, etc., to South Africa, recently.

W. P. NILES may build a roller flour mill at Wellington, Ont., the village having granted exemption from taxes.

A. E. CARPENTER has sold out his interests in the Hamilton and Toronto Sewer Pipe Company to Henry New.

E. L. PERKINS and W. H. Heine are interested in organizing a wood-working company, at Norton Station, N.B.

THE Canada Screw Co., Hamilton, Ont., is applying for an extension of the exemptions enjoyed for some years past.

H. & F. GIDDINGS & Co., Granby, Que., will build a new furniture factory, 50 by 100 feet, and five stories high, in the spring.

THE Exploits Lumber Co. is to be incorporated to do a large lumber business in Newfoundland. The capital is English.

IT is said that a combine including every wire rod, nail, and other wire product in the United States will be in operation before Feb. 1st.

GEORGE MCARTHUR, St. John, N.B., has been awarded the contract for building Doran's Hotel, Windsor. The contract price is over $20,000.

THE work of enlarging and improving the Rathbun Company's cement works, at Napanee Mills, Ont., is being pushed by a large staff of men.

THE town of Wardner, B.C., which has grown up where the Crow's Nest Pass Railway is to cross the Kootenay River, is experiencing quite a boom.

THE Dominion Elevator Company is now erecting elevators at the following points: South Edmonton, 20,000 bushels; Laduc, Wetaskiwin, and Red Deer, 15,000 each.

THE town of Welland, Ont., is to be piped at once for a natural gas supply. The rates charged will be the same as in Dunnville, Ont., *i.e.*, $35 a year for furnace; $24 for a cook stove; $19.35 for a heater.

AN order has been received at the C.P.R. car shops, at Perth, Ont., to build 20 first-class passenger cars and 10 sleepers. Hitherto only freight and box cars have been manufactured at the Perth shops.

INCORPORATION has been granted to M. M. Boyd, W. T. C. Boyd, Bobcaygeon, Ont.; G. Boyd, J. Wickham, Toronto; J. D. Flavelle, and J. G. Edwards, Lindsay, as the Cowichan Lumber Co., Limited. Capital, $150,000.

THE case of Dale *v.* the Riordon Paper Mills, Limited, Merritton, Ont., has been settled for $1,500 out of court. James Dale, who was severely scalded at the mill some months ago, brought an action for $2,500 against the company.

J. T. CHILD, C.E., of Child & Wilson, Calgary, N.W.T., was at Lethbridge recently making an estimate of the probable cost of a system of waterworks for that town. Medicine Hat is also looking for a waterworks system, it is said.

C. GUIMOND, Beauharnois; C. F. Lalonde, Montreal; J. Leduc, J. B. Roy, Delia Rochette, Beauharnois, Que, are applying for a Dominion Charter as the Star Iron Company, Limited, to manufacture furnaces, etc. Chief place of business, Montreal; capital, $60,000.

THOS. DOHERTY, Sarnia, Ont., the inventor of the famous iron casting process, is now engaged upon the invention of a further improvement in this process of iron production, of which great things are predicted by those who have been given an inkling of the new idea.

THE creditors of Robert Saxby, engineers' supplies, Toronto, met recently, when a statement was presented showing liabilities of $3,200, with assets of about $4,000. The chief claims are: John Herrington estate $1 700, secured by a $1,000 mortgage and $300 note, endorsed; E. E. Cooch $550, Bank of Commerce $100, Royal Oil Company $125, and Robert Saxbury, jr., $300. The assets consist of land $3,500 and the remainder stock and book debts.

THE company which is working the peat beds near Welland, Ont., is going into the manufacture of artificial marble from gypsum.

THE city engineer, Montreal, has asked an appropriation of over $1,000,000, chiefly to be spent on new sewers and enlarging old ones.

THE town of Magog, Que., has recently installed a municipal electric lighting plant, and now proposes to add a system of water supply, the same power plant being used as for the lighting system, and the pumping being all done during the day when there is no demand for electricity.

J. M. LAVOIE, E. Lavoie, O. Matton, Ottawa; A. Lavoie, Donald, B.C.: J. M. McDougall, Hull, Que., have been incorporated under the Dominion statute as the Lake Deschenes Milling Company, Limited, with a total capital stock of $40,000, to build flour and other mills, and do a general milling business.

THE average nightly attendance at the Toronto Technical School was 230 during October and November. The building is to be enlarged for the use of the school by the University of Toronto, which owns it, at an expense of $26,000. The Technical School will pay a rental of $2,000 per year for 21 years.

PLANS have been brought forward for extending the Bonsecours market, Montreal. The plan would extend the market to Jacques Cartier square, and then take in property and land on St. Paul, Bonsecours and Leroyer streets, extending the latter street through to Bonsecours street; a large square would thus be added to the market.

THE Ontario Sewer Pipe Company, Mimico, Ont., has completed what is said to be the largest sewer pipe kiln in the world. It measures 36 feet 7 inches in diameter, seven inches larger than the one built by the Great Western Sewer Pipe Company, Ohio, and about 19 inches larger than those of the Black Horse Sewer Pipe Company, Virginia

THE Acton Tanning Co. and Beardmore & Co., Acton, Ont., are putting up new buildings. The carpenters are busy on two new hair houses, one for each establishment, 32 x 50. J. A Speight & Co. are finishing two large cedar water tanks for the Acton Tanning Co., fifty-seven feet in circumference and twelve feet deep.—*Acton Free Press*, Nov. 25.

A NEW company has been formed to operate the Coldbrook Rolling Mills, near St. John, N.B. The new company, which is styled the Coldbrook Steel and Iron Company, has appointed W. H. Thorne & Co., wholesale hardware merchants of St. John, as their selling agents, The company will manufacture bar iron, railway spikes, and wrought spikes.

A PRACTICAL demonstration of a new process of jointing pipes took place recently at the Caledonia Iron Works, Montreal, in the presence of some influential pipe-makers, contractors and others. The process of making and fixing the ring joint is an entirely new departure from the customary methods employed in jointing pipes, and overcomes the difficulties incidental to pouring and caulking lead into pipe joints in wet trenches. A full description of this process appears in THE CANADIAN ENGINEER. The inventor is D. J. Russell Duncan, C.E., 28 Victoria street, London, S.W. The ring joint is made with cold sheet lead, which is circumferentially contracted and indented by the pressure of a contractible tapering wedge and an external compression ring.

IN connection with the mention made in past issues of THE CANADIAN ENGINEER of the different appearances of strange aerial bodies, by many believed to be air-ships, the following press despatch, dated from Pittsburg, Pa., may be of interest: "It has at last been discovered who the incorporators of the Atlantic and Pacific Aerial Navigation Company are. The company, which is officered by C. A. Smith, president, and M. A. Terry, secretary, both of San Francisco, was organized to manufacture the air-ship of Hiram S. Maxim, inventor of the Maxim gun. It is said by persons connected with the company that last summer a trip was made in a Maxim air-ship from San Francisco to Cleveland and back in three days. Mr. Maxim furnishes the following description of his vessel: It occupies 106,000 cubic feet of space. The propelling power is a 105 horse-power naphtha engine. The cylinder engine and all other parts of the machine, so far as practicable, are made of aluminum, which was purchased of the Reduction Company here. The ship now weighs about 5,000 pounds, and will, its friends claim, carry more than a ton-weight of provisions and passengers. The naphtha for the engine will be stored in cases, which are supposed to hold enough to drive the ship around the earth without replenishing the tanks. The tail that projects upwards from the stern of the ship is intended to direct it up or down as a bird directs its movements with its tail. The rudder is to change the course from right to left. Motive power is secured by the big aeroplane at the stern, which is driven by the naphtha engine. It is stated that a speed of one hundred miles an hour has been attained without straining the machinery."

MONAGHAN & SUTHERLAND, contractors, Halifax, N.S., assigned not long ago to T. Frank Courtney.

THE Strathroy Furniture Co. is building a sawmill in connection with its factory, capacity, 15,000 feet per day.

RICHARD SCHOFIELD, Toronto, recently put in an electric mail-marking machine in the Hamilton Post Office.

POWER & SON, architects, Kingston, Ont., are preparing plans for a new elevator for Richardson Bros., Kingston.

AN acetylene gas company is to be established in Carleton Place, Ont., and has already asked for street privileges.

THE Goldie & McCulloch Co., Galt, Ont., recently shipped a large boiler to the Ontario Rolling Mills Co., Hamilton.

THE Methodists of Brandon, Man., will build a $30,000 church next season. S A. Bedford is chairman of the building committee.

HARLAND BROS., Clinton, Ont., hardware, are putting in a 40-light acetylene machine and will furnish some neighboring firms with light.

THE Waterloo, Que., waterworks, owned by Gould & Wilson, will shortly pass into the possession of the municipality, which gives in the neighborhood of $21,000 for them.

Two carloads of screens from the Jenckes Machine Co., Sherbrooke, were received at the mills of the Chicoutimi Pulp Co. recently, and are now being set in place.

THE Montreal City Bill, now before the Quebec Legislature, proposes to give the city the right to borrow $250,000 for the extension and improvement of Bonsecours market.

THE Canadian Typograph Co , manufacturers of the well-known E. & D. bicycles, have received orders for 150 of their wheels from South Africa, nearly 100 of which have already been shipped.

FOUR municipal by-laws were voted on in Galt, Ont., Jan. 3rd, all of which were defeated, viz. : $7,000 for market extension; $8,000 for new fire hall ; $3,000 for hospital sewer ; $1,800 for electric fire alarm.

THE Windsor, N S., Plaster Co. commenced grinding plaster early in December, and is now able to supply the celebrated Selenic Cement. This is the first manufactory in Windsor to begin work after the fire.

THE plant of the Phelps Machine Co , Eastman, Que , has been bought out by the Jenckes Machine Co., of Sherbrooke, which will continue the manufacture of the Dake engine in the Sherbrooke works.

THE City of Belleville, Ont., owns its gas works. The original investment was $14.400. The dividends in twenty years have amounted to $28 224 in addition to two per cent. which has been put aside each year for repairs and improvements.

R. MACKIE has been appointed engineer of the new sewage disposal works, Hamilton, Ont., at a salary of $600. Mr. Mackie holds a first-class certificate, and has been engineer at the Hamilton Bridge Co., the Copp Bros., Limited, and the Rolling Mills.

AT the annual shareholders' meeting of the Dominion Wire Manufacturing Co., Montreal, the following directors were elected by the shareholders: James Cooper, president; C. W. Vollmann, vice-president; J. C. McCormick, managing director ; F. W. Fairman, H. Horsfall.

AT the annual meeting of the Montreal Metal and Hardware Association the following officers were elected: President, George E. Drummond; vice-president, J. B. Learmont ; treasurer, J. W. Pyke ; directors, Charles Cassills, Frank Caverhill, Robt. Gardner, and C. L. Letang. A resolution was passed endorsing the limitation of credit to four months and 3 per cent. for cash.

WATER was let into the penstock at the pulp mills at Chicoutimi on the 15th ult. The mill, it is expected, will be in full operation by the 20th. The development of the water power in connection with the mill was undertaken by the Jenckes Machine Co., of Sherbrooke, Que., which used four special Crocker wheels for the purpose. The wheels give excellent satisfaction under the usual head of 70 feet.

DR. C. J. EDGAR, North Hatley, Que., has formed a partnership with W. O. Roy, of Montreal, and acquired a water power on the Massawippi River, a little below the village. They will furnish electric lights and power to North Hatley, Eustis and Waterville. A contract has been made with the Jenckes Machine Co., Sherbrooke, Que., for developing the power, and the whole plant will be put in at once.

J. P. CARRITTE, St. John, N.B., and J. W. Patterson, of the Patterson Manufacturing Company, Montreal, have contracted with the People's Heat and Light Company, Halifax, N.S., for the company's tar output, and will have erected as soon as possible a factory on the North-West Arm, for the manufacture of tarred roofing and building paper, and all bi-products of tar. They have bought plant in New York, and plans have been prepared for the buildings. The works will be ready for operation in the latter part of February, it is expected.

YARMOUTH, N.S., will build a $15,000 school.

THE reservoir of the Parrsboro, N.S., waterworks has been completed.

E. D. SMITH, Winona, Ont., fruit grower, is spending $5,000 on a cold storage warehouse.

THE Detroit Lubricator Co. has recently received orders for 100 locomotive lubricators, which are to be shipped to China and Japan.

MADISON WILLIAMS, who is now proprietor of the foundry and machine shop of the Paxton, Tate & Co. estate, Port Perry, Ont., is doing a good business.

THE new pulp mills of the Royal Paper Mills Co. at East Angus, Que., are rapidly nearing completion. The contract for the entire tank work has been awarded to the Jenckes Machine Co., Sherbrooke, Que.

THE Rev. D. B. Marsh, Black Heath, Ont., inventor of the Marsh stethophone, is now taking out patents in the United States and several European countries. Mr. Marsh has made a number of improvements on the instrument since the patent first issued in Canada

THE trouble between the Customs Department and the Canadian agents of the La France Engine Company has been settled by the payment of $441 additional duty and fine. The company, in a letter, gave the lowest price of the engine as $4,200. When it reached Canada it was entered at $3,570, that is 15 per cent. less than $4,200, This $630 was understood to have been the Canadian agents' commission at 15 per cent. The Customs authorities have now decided that the correct value for duty was $4 200, and has collected 35 per cent. on this $630 deducted, with a fine of 100 per cent. on the amount of undervaluation.

SINCE the publication of the article on towns' water supply in our June number, which points out the poisonous effects of lead pipe on drinking water, we have received from E. Walker & Co., water pipe manufacturers, Heckmondwike, Yorkshire, England, a sample of their wrought iron pipe lined to a thickness of over one-sixteenth of an inch with block tin, and a suitable connecting coupling lined so that the water cannot possibly come in contact with the iron, even at the joinings. They also make iron pipe with a non-conducting material or insulator placed between the iron pipe and the block tin lining, which they claim prevents frost penetrating the pipe and freezing the water. This overcomes the difficulty pointed out, and supplies a pipe almost everlasting in wear, and that cannot rust, or in any way destroy the purity of the water. The sample can be seen at the office of THE CANADIAN ENGINEER.

J O. LA FOREST, superintendent of the Montreal waterworks, has again called the attention of the city council to the danger that will attend further neglect of the long-needed waterworks extensions. The high level reservoir contains about 1,750,000 gallons, or less than 24 hours' supply for the district it serves; while the only engine capable of duty at the McTavish street station is worked beyond its capacity, so that there is no time for overhauling in case of accident. The water supplied from the high level reservoir has increased enormously in recent years. In 1885 it was 48 986,086 gallons, while in 1896 it had risen to 662,572,822 gallons. A new engine is urgently needed at a cost of about $40,000, including erection, and an additional boiler at a cost of $19,650, including alterations to the buildings. The cost of connecting the two sections of the reservoirs to the suction pipe, and the continuation of the 20-inch main to the high level reservoir, will add about $10 000 more to the cost of the needed improvements.

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# The Canadian Engineer

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## The Canadian Engineer.

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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### CHAP. V.

### ROADBED CONSTRUCTION.

### ARTICLE 23.—MASONRY BRIDGE PIERS.

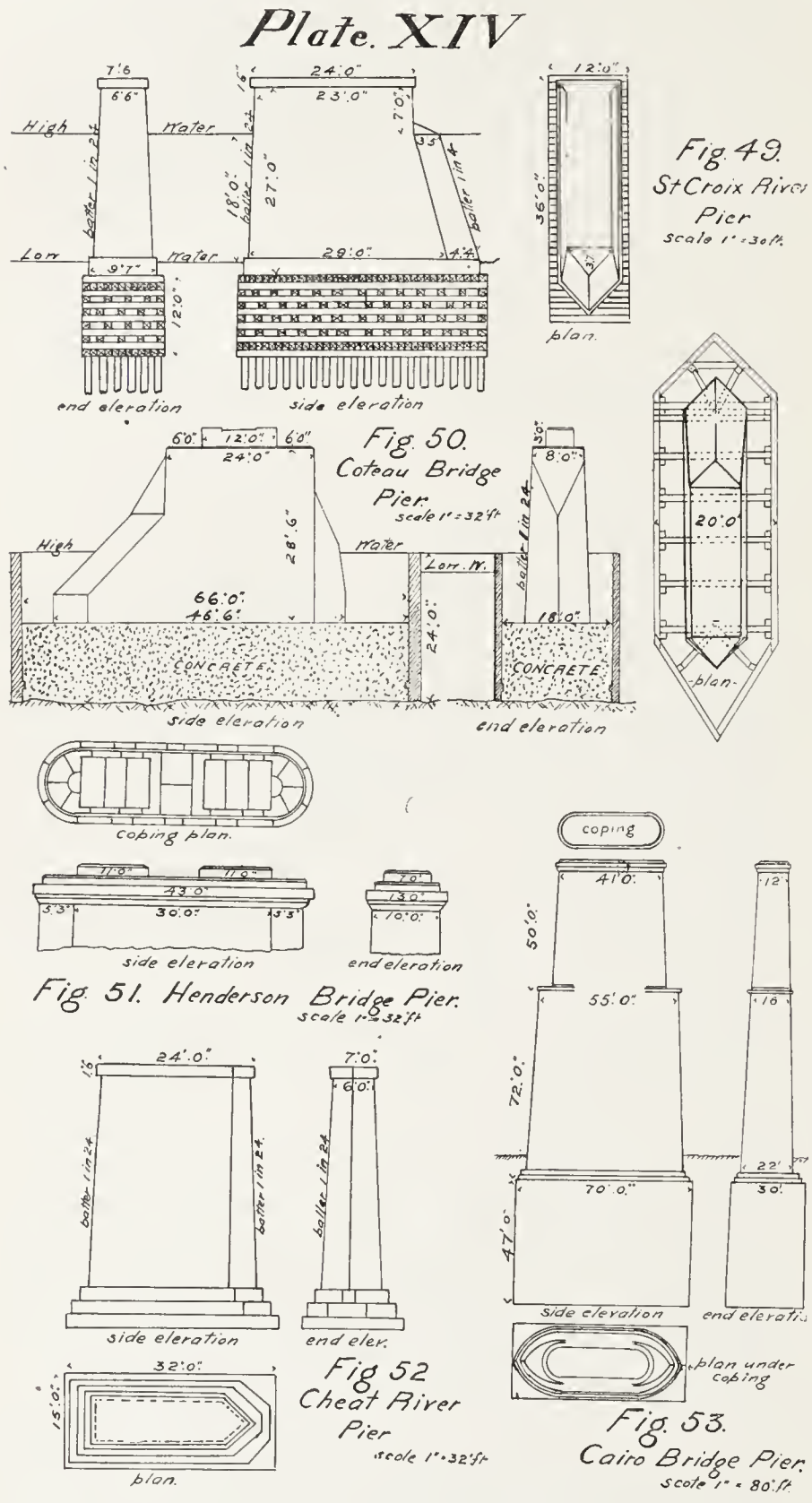
The material most commonly used for masonry pier construction is stone, although in certain cases brick may be cheaper and also satisfactory; but wherever there are strong currents of water or jams of ice or logs, brick is hardly suitable, as the individual pieces are liable to displacement; but concrete piers are becoming quite common in certain parts of America, the compact and simple form of a pier lends itself readily to concrete construction, the ebb and flow of tides will not affect well made concrete whereas it has a disastrous effect often even on the heaviest class of masonry, percolating through the many joints loosening the stones and mortar; concrete piers are usually much cheaper than first-class masonry work, and even the compromise of a pier with the sides and top of stone and the interior of concrete, offers considerable saving. In designing piers located in river beds we have three special questions to study, namely, the dimensions and construction of the coping, the batter of the sides to insure stability, and the design of the cutwaters; of course the question of foundations enters into designing this class of work even more seriously than with structures built on land, but the subject of foundations will be taken up in a more general way applicable to all structures.

(1) The coping dimensions will be determined by the width apart of the trusses, the size of the bed-plates, and the loads to be carried locally on the masonry work, the variation would be for single track roads, from say 4 feet by 16 feet under coping for small deck trusses to as large as 12 feet by 40 feet for long through spans. The coping should project two or three feet beyond the bed-plates at the ends, and six inches to two feet at the sides, depending on the weight of the span. Copings should consist of an 18-inch thickness of very strong carefully made concrete, surfaced with a layer of 1 to 1 mortar before the concrete has set, or if of stones, they should be large, well-bedded, cut all over the top surfaces by fine pointing, pean hammering, or in some way giving a good surface for the bed-plates; the vertical joints should be cut and preferably the beds also; but the faces look better with the quarry face left on, if the rest of the pier is rock faced ashlar. They should be dowelled into place, or clamped to one another, and so arranged that the pedestal plates of the bridge trusses will come *exactly* on the centre of a large stone, or if one stone cannot be found large enough to distribute the load, a large, deep pedestal block should be cut for the purpose and placed on top of the coping; for very large trusses, a steel pedestal is constructed to distribute the load over several coping stones (*e.g.*, new Victoria Bridge). Coping plans showing the exact size and position of each stone should be furnished the contractors, and it is a mooted question, whether better results as to exact surface, etc., can be obtained by bedding in mortar, or by shimming up the whole coping to an exact level on wooden chips, then pointing up all the outer bed and vertical joints, and pouring liquid grout into the receptacle of interior joints and beds thus formed until every crevice is filled, the latter plan is probably preferable, if care is taken to have the joints and beds open enough to secure their being thoroughly filled, particularly the beds.

(2) The batter of the sides is usually 1 in 12 or 1 in 24 and is a matter of appearance, as vertical piers would look top heavy, but in each case a calculation should be made for stability, under the most unfavorable circumstances; considering the stability in direction of the railway line, the forces acting would be (*a*) the wind blowing at 45° to the direction of truss, on the truss, train and pier, at say 40 lbs. per square foot, the force of a fully braked train covering one or two spans depending on the location of the expansion rollers, at say, 10 per cent. of the weight of the train, and vertical loads which would consist of a *loaded* span and the weight of the pier itself; the resultant of these forces should not fall appreciably outside the middle third of the base, (*b*) with the wind as before, but

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

blowing on the truss and pier only, and the vertical loads of an *unloaded* span and the weight of the pier itself, the same criterion for stability should be applied as in (*a*), and in either case the remedy for instability would be to increase the batter, or introduce steps or offsets of, say, 6 inches every 10 or 12 feet, which would have the same effect. The stability of a pier at right angles to the bridge is practically never in question unless of very great height, in which case similar tests would determine what the necessary length of base should be.



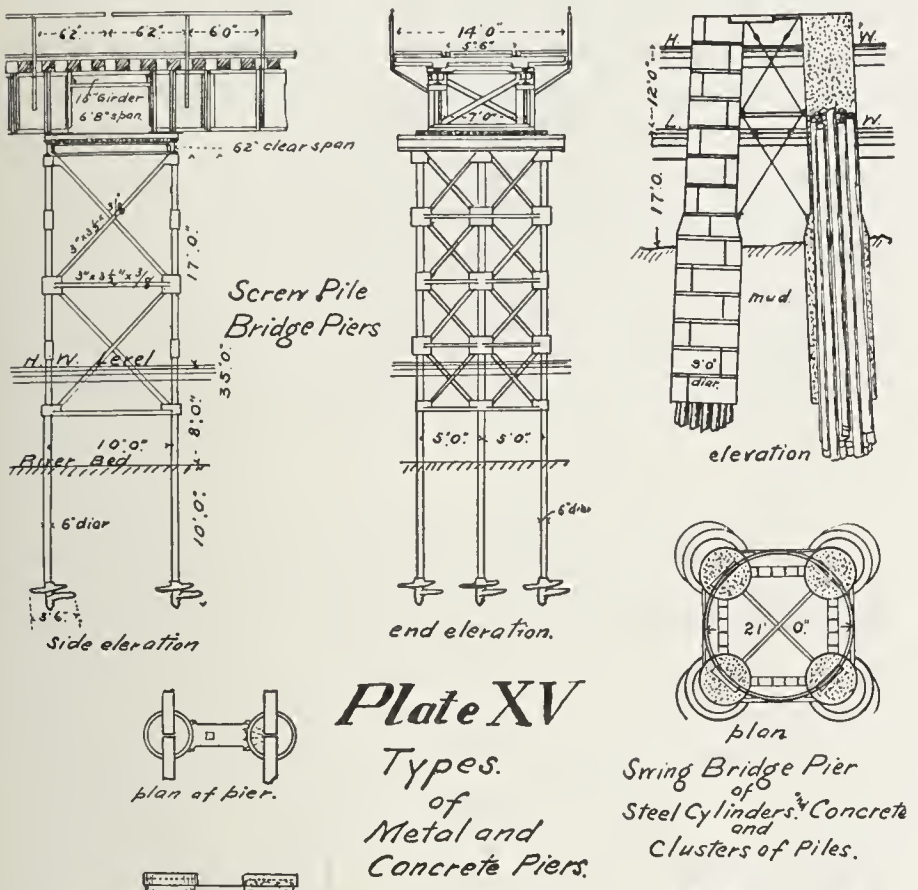

(3) Cutwater designs:—Wherever there is any appreciable current in a river, it is necessary to construct the up-stream end of the pier of such a form that it will divide masses of driftwood, ice, logs, etc., as well as the current itself. Probably the simplest form is that shown in Fig. 52, which wlll not cost appreciably more to construct than a square pier, as the nose is a right angle and the faces of ordinary quarry-faced ashlar, but such a form is suitable only for streams carrying light ice or moderate jams of logs; in place of this the more ornamental forms shown in Figs. 51 and 53 would be equally satisfactory, especially the latter, but cost considerably more, and should therefore be used only on very important structures.

Where piers are to be placed in swift currents, or in any stream carrying heavy jams of logs, or thick floes of ice, their cutwaters should be of designs similar to Figs. 49 or 50. The cutwater of the former hardly extends high enough and is not flat enough for Canadian rivers, and besides it lacks the valuable addition of a small pointed lower end, which is introduced to eliminate an eddy at that point in swift currents, which tends to undermine the end of the pier, unless on solid rock. Probably the St. Croix pier and cutwater are suitable for the conditions they were designed for, but the intention of the design on Fig. 50 is that the jams will rise on the nose and split in two, passing on harmlessly.

Stone masonry bridge piers will cost from $9 to $15 per cubic yard, depending on their height, size and the cost of quarrying, transporting and cutting suitable stone. If expensive cutwaters are needed this will add to the cost; those used under severe conditions being of a first-class cut stone construction of large dimensions, clamped together and dowelled also, with a strip of boiler plate added to the nose to prevent dislodgement of stones. The following specification of first-class bridge masonry will apply to both abutment and pier construction, but in many cases a less severe specification has resulted in satisfactory and durable work.

*Specification for First-Class Bridge Masonry.*—"This class of masonry will be ranged rockwork of the best description, from stone of approved weathering qualities, and will be laid in suitable cement mortar (1 to 2 natural, or 1 to 3 Portland). The face stones will be accurately squared, jointed and bedded, and laid in courses not less than 12 inches thick, decreasing in thickness from bottom to top of walls; the joints and beds to be less than half-inch and joints well broken, no break to be less than nine inches. The stretchers to average at least $3\frac{1}{2}$ feet in length with 3 feet as a minimum, to have at least 16 inches bed, and always at least as much bed as rise. The headers to have a width of not less than 18 inches, and to hold the size back into the heart of the wall that they show on the face; they shall occupy at least one-fifth of the area of the face of the wall, and be practically evenly distributed over it, so that the headers in each course shall divide equally or nearly so, the spaces between the headers in the next course below. When the walls are not more than $3\frac{1}{2}$ feet thick, the headers shall run entirely through, and when between $3\frac{1}{2}$ and 6 feet thick, there shall be as many headers of the same size in the rear as the front of the wall, and the front and rear headers must alternate and interlock at least 12 inches with each other. In walls over 6 feet thick, the headers shall be at least $3\frac{1}{2}$ feet long, alternating front and back as just described, their binding effect being carried through the wall by intermediate headers of a similar character. The stretchers in the rear of the wall, and the stones in the heart of the wall shall be of the same general dimensions and proportions as the face stones with equally good bed and bond, but with less attention to vertical joints, and must be well fitted to their places, and carry the course evenly quite through the wall; a header shall in no case have a joint directly above or below it, but rest entirely on a stretcher at the face; any small interstices that may remain in the heart of the wall shall be carefully filled with mortar and spauls. The face stones shall be left rough on the face, with no projection of more than three inches from pitch lines, and two-inch drafts will, in general, be carried up and around all projecting angles. In the construction of piers, it is understood that the description above given for face work shall apply to both ends and both sides of the pier. Copings are to be cut and dowelled or clamped according to coping plans furnished, the top shall be crandalled and pean-hammered,

or otherwise brought to a smooth surface, and so arranged as to bring the pedestal plates of the trusses exactly on the centre of especially large coping stones of dimensions given on the plans."


62' clear span
Screw Pile Bridge Piers
Side elevation
end elevation.
elevation
plan
plan of pier.
Plate XV
Types of Metal and Concrete Piers.
Swing Bridge Pier of Steel Cylinders, Concrete and Clusters of Piles.
Cast Iron Cylinders sunk by Open dredging and Compressed air.
Steel Cylinders and Concrete with Rock-filled Crib.
plan.

ARTICLE 24.—METAL OR METAL AND CONCRETE PIERS.

On Plate XV. are shown several applications of metal and concrete for bridge piers. The method by screw piles founded in mud is quite unique and has not been attempted in America for railway bridge piers, but the steel cylinders filled with concrete and founded either in mud on piles or anchored to the rock by iron dowels are more familiar. For light highway bridges this method is quite suitable, but it is probable that, except in the form of one large cylinder, as a cofferdam to a pneumatic caisson, both filled with concrete and sunk in waters not needing cutwaters, their use for railway bridge piers will be exceptional, as the more massive forms shown on Plate XIV. will be better able to withstand the vibrations of trains and impacts of ice, etc.

ARTICLE 25.—IRON VIADUCTS OR TRESTLES.

The features usually under the control of the railway engineer are the general lay-out, the design and construction of masonry, and the erection of iron work; the detail designing of the iron being essentially a branch of bridge-work.

(*a*) *General lay-out.*—This has resolved itself in America to be, in general, a system of braced independent towers and suspended spans (see Fig. 54); the towers are usually about 30 feet spans, with posts vertical in side elevation; and, in end elevation, the girders are spaced 8 to 10 feet centres, and the posts battered at 2 to 3 inches per foot, depending on the allowance for wind, the aim being to avoid tension in the windward pedestals at the most unfavorable instant. The suspended spans are usually also plate girders of 30 feet to 60 feet span, depending on the height, the greatest economy being claimed when the cost of girders and longitudinal bracing is equal to the cost of towers and pedestal masonry. The usual design is with diagonal rods acting in tension and the girders resting on top of the posts, with slotted holes for expansion, but some late designs are for rigid, riveted bracing and posts extending to the tops of the girders, which are riveted to the webs of the posts, temperature changes being taken up in expansion pockets every 100 to 200 feet. This system is theoretically more rigid, but costs more and demands a perfect system of pedestals, any settlement being dangerous to a proper distribution of stress.

In estimating the weight of iron for approximate work, the following rule may be useful:

The weight of metal in the towers and bracings, in pounds, is equal to about $8\frac{1}{2}$ times the longitudinal section area in square feet of the ravine below the line of girders and between the faces of abutments; this is based on a 100 ton consolidation engine and a high viaduct, say 100 feet, this will be changed to say $9\frac{1}{2}$ times for a viaduct 50 feet high, and $10\frac{1}{2}$ for a viaduct 35 feet high with the same weight of engine. The weight of girders, in pounds, may be estimated at $(9l + 100)$ pounds per foot run of a span, where $l$ = length of span. The price of iron varies considerably, with cost of erecting falsework, if any, and cost of erection and freight in general, but is about four cents per pound, in place, as a minimum. The floors of viaducts usually consist of say 8-inch by 10-inch oak ties about 12 feet long on their edge, boxed one-inch over the girders, and fastened to them by hooked bolts which pass through the guard rails and hook under the upper girder flanges; the spacing should be not more than six inches clear, and guard rails either double or with an inner guard rail of ordinary flanged rail. Some recent designs, however, call for solid floors of steel troughs filled with ballast and with ordinary track ties, which, certainly, would lessen vibration and increase safety in case of slight derailments.

(*b*) *Pedestal Masonry.*—The greatest care must be exercised in laying out and building the abutments and pedestals, as any error in position or appreciable one in height is very serious, because the iron work, being manufactured at a distance contemporaneously with the masonry, is shipped to the spot partially assembled, and cannot be afterwards altered except by a slight shimming up of pedestals built too low. The shoes of the columns are always bolted down to the copings, and in high structures these bolts should be built into the pedestals 5 or 6 feet, by passing through the stones as they are laid in place (see Fig. 54), the bolt holes are afterwards filled tight with sulphur, lead, or neat cement grout, while if the structure is not very high or subject to heavy winds, the anchor bolts are only sunk into the coping stones, dovetailed by wedges and cemented as before. Pedestal masonry is sometimes built of well burnt brick covered by a stone coping, and the use of monolithic concrete is especially adapted to this class of work, as it permits of the anchor bolts being buried in the concrete to any depth during construction. In any case the best class of work must be done, as the strains and thrusts acting are of higher intensity than in ordinary masonry, and the pedestal is not only under considerable vibration for so small a

mass, but may be put in tension on the windward side of high structures. The cost of stone pedestal masonry will vary with the conveniences for handling small quantities of large stones at each spot, and with the amount of cutting required, from $10 to $15 per cubic yard, whereas a very high class of concrete may be done for at the most $8 per yard as there is nothing to move from place to place but the plank molds and mortar box. The coping of concrete pedestals should be made very strong, say, 1 cement, 1½ sand, 3 stone, with a layer of 1 to 1 mortar for 1½ or 2 inches thick on the top and sides, put on at the same time as the rest is being built, and incorporated with it by vigorous trowelling and ramming, etc.

Plate XVI

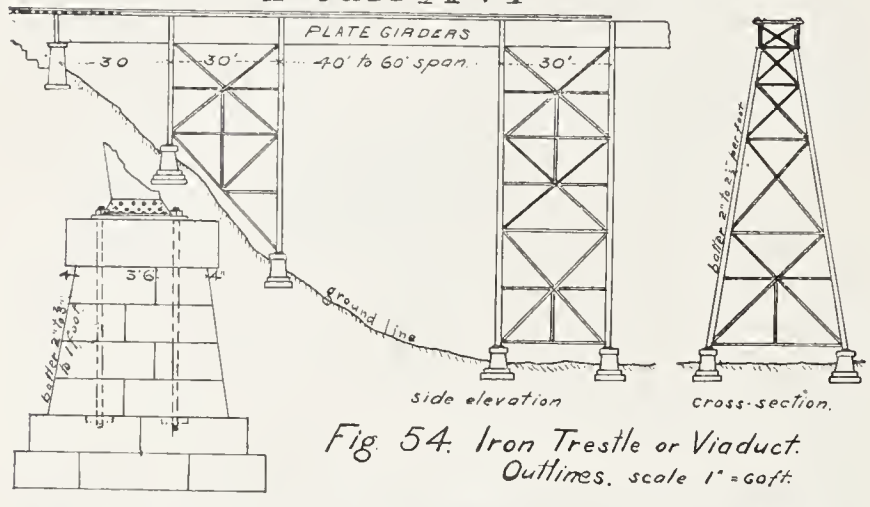
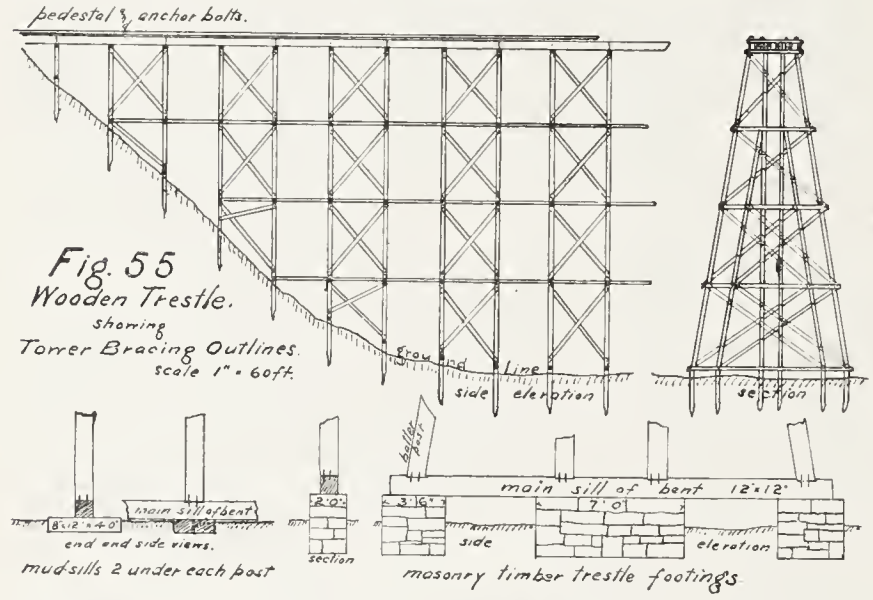



Fig. 54. Iron Trestle or Viaduct. Outlines. scale 1" = 60ft.



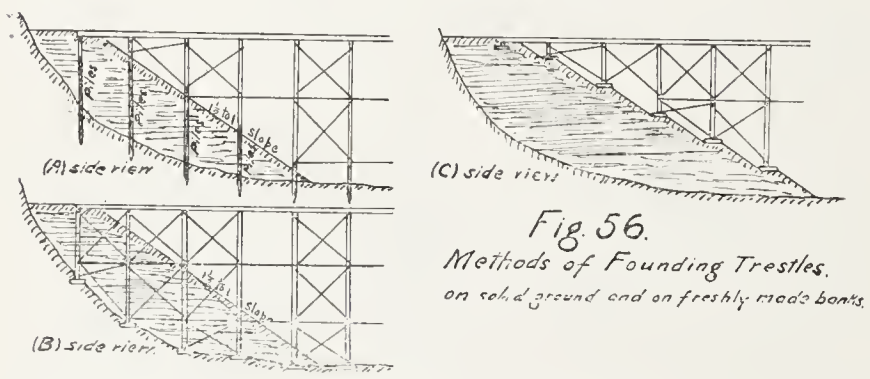




Fig. 56.
Methods of Founding Trestles.
on solid ground and on freshly made banks.

## Article 26.—Wooden Trestles.

In America where timber is plentiful, cheap and widely distributed, where capital is often limited and construction hurried, and in inaccessible regions, the use of wooden trestles has been of great economic value. It is yet a factor not to despised; and although their design is apparently not very difficult, yet it should be thoroughly understood by the young railway engineer in its many phases at an early date in his practice. We have probably 100 feet per mile of railway in Canada, or about 300 miles altogether, and we may safely figure on a continual renewal of at least half of this every seven or eight years, which represents an annual drain on our forests for this purpose of perhaps 40,000,000 F.B M., while the other half will be replaced by earth, stone or iron as fast as it decays. Gradual separation and sizes of timber available have produced several distinct types, each of which has its advocates; the greatest diversity exists in every detail from floor to foundation, and will be discussed somewhat, in order to obtain a broad view of the various methods in use.

(*a*) *Foundations.* — These may be classed as (1) masonry footings, (2) piles, and (3) mudsills.

(1) Stone work suitable for culvert walls is used for the masonry footings and will cost about $4 per cubic yard; the heaviest and longest stones should be used for the top course, and the sill well bedded on it in mortar. It is not necessary to bolt the sills to the masonry if the timber bents are braced longitudinally; and, sometimes, where it is anticipated that an iron viaduct will replace the wooden one at the first renewal, it may pay to build the batter post pedestals under every alternate bent, of first-class pedestal masonry, which will serve as pedestals for the columns of the iron viaduct when needed (see Fig. 56).

(2) When foundations are deep or soft, or less expense is desirable, a pile is driven under each post of each bent, and the sills rest on and are drift-bolted or tenoned to the piles; for 15-foot bents and a 100-ton engine, a pile will carry one-quarter of the load on a bent when it penetrates less than about two inches under a blow from a 2,000-pound hammer dropping 25 feet; but if such a penetration cannot be obtained without great depth of pile-driving it may pay to use more piles. (See Fig. 55.) Whenever a trestle is less than 15 feet high, framed bents may be dispensed with, and the piles left driven up to the bottom of the caps on which the stringers rest, in which case the outer piles are driven to a slight batter, and then pulled in, as the cap is drifted on, to a total batter of two or three inches per foot, or if the bent is only five or six feet high the piles may be all driven vertical; in either case, the centre piles are five feet apart and directly under each rail; usually a pair of × or sway-braces is bolted onto each bent, but no longitudinal braces are necessary. It is not good practice to build these pile trestles over 15 feet high unless for temporary work, as the vibration from traffic loosens the piles, and the rot at the ground surface is rather rapid and wasteful of material cut off, in case of renewals.

(3) *Mud Sills or Bank Sills.*—These consist of six or eight short cross-sills under the main sill of each bent, the usual dimensions are 8x12 inches by 5 feet long laid on flat, unboxed, which facilitates shimming by means of planks or boards under the main sills, and the bents will not get out of plumb if longitudinal braces are used. (See Fig. 56.) Other special foundations are:—Cribwork filled with stone where there is a current of water, a grillage or floor of timber in case of soft submerged ground, and holes cut in the rock, carrying the ends of the posts without any sill on steep solid rock side hill.

(*b*) *The founding of end bents.*—This is generally a difficult problem, as the freshly made embankments at each end of the trestle settle rapidly. Fig. 56 shows the three methods in ordinary use. Of these (*A*) is undoubtedly the best, but most expensive, as pile driving on sloping banks costs considerable; such piling should be done after allowing the bank to settle as much as possible, and the piles should be well driven into the solid ground to prevent them being shoved out of place longitudinally. (*B*) This method is pernicious, the embankment always contorts the trestle, no matter how well braced, the posts rot off at the ground surface, and it is also expensive and often delays the construction of the embankment; it has little to recommend it, unless the whole trestle is to be soon filled in. (*C*) This is seemingly a flimsy method, but is found very satisfactory in mild climates at least. Each

bent is supported on eight or ten mudsills, and as the bank settles a bridge gang surfaces and relines the trestle by shimming between the bents and bank-sills; after a few months, when the bank has become firm, very little attention will be required, and it is always convenient for repair or renewal, and nothing rots but the mudsills. It has also the especial merit of providing an elastic and gradual approach from the rigid trestle to the sinking fresh bank, which the first and second methods do not present. It is the cheapest method, and its only demerit is that it is affected by frost in the spring in cold climates.

*Plate XVII*

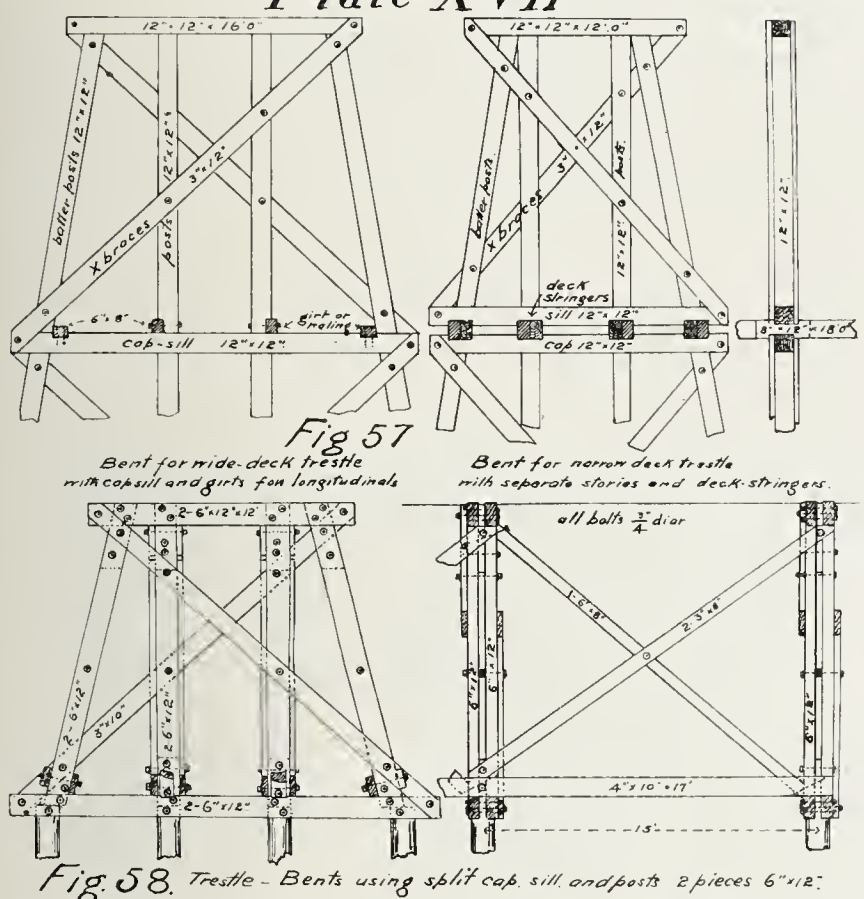



Fig. 57

Bent for wide-deck trestle with capsill and girts for longitudinals

Bent for narrow deck trestle with separate stories and deck-stringers.




Fig. 58. Trestle - Bents using split cap. sill and posts 2 pieces 6"×12"

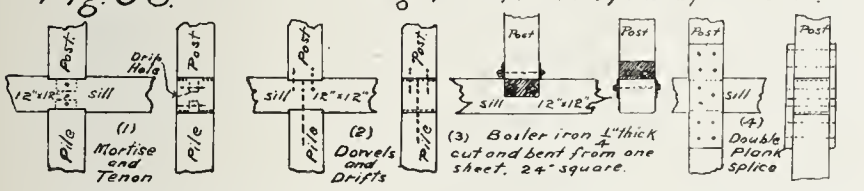



Fig 59. Methods of connecting posts with caps and sills.

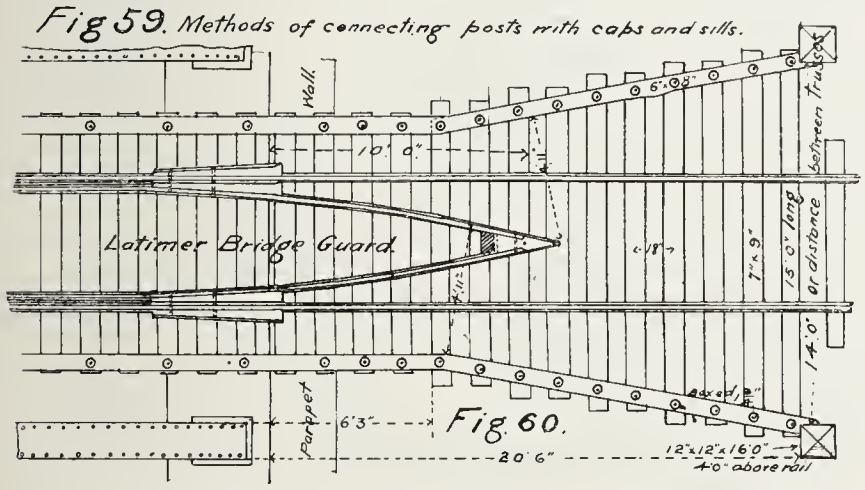



Fig. 60.

(*c*) *Trestle Bents and Systems.*—The ordinary styles of bents are with four posts, which are increased to six posts in very high trestles, each story or deck being braced by one or two pairs of cross or sway braces—the plumb posts being five feet apart, and batter posts sloping at from two to three inches per foot.

The longitudinal braces consist of cross braces and horizontal ties. The former are so grouped as to form towers and spans alternately, but the horizontal ties run the entire length of the structure. Speaking generally, low trestles on tangents need very little longitudinal bracing, while high ones on sharp curves need very much; between these two, the extent, disposition and sizes of such bracing will be a matter for the judgment of the designer, but all such braces should be bolted and not spiked, as vibration from trains will soon loosen the latter, and even bolts from the same cause and from shrinkage of timber need to have their nuts tightened two or three times before the rust locks them into place. Sway braces may, however, be partially bolted and partially spiked with pressed spikes.

The posts, caps and sills are usually of solid timbers 10 inches by 10 inches, 10 inches by 12 inches or 12 inches by 12 inches in section, the latter being most common. (See Fig. 57.) And such timbers make the best structures; but large timbers are often hard to obtain at reasonable prices, and in such cases, the style shown in Fig. 58 is found satisfactory and is easy to repair and renew. The split caps, sills and posts are usually 6 inches by 12 inches well bolted together; but the cost of such bolting, and danger of some of the bolts working loose are objections to the system. On the other hand, water is not so apt to lodge or rot where timbers are so narrow. An extension of this system is the "cluster bent" trestle, the posts being of four pieces of 6 inches by 6 inches, breaking joint and bolted to split caps and sill, with the cross braces acting also as separators. This style is advisable only in localities where timber is obtainable only in small dimensions, and of poor quality, its advantage being facility of repair; while the trestle itself is not so stable or durable as if made with larger timbers.

(*d*) *Joints and Fastenings.*—Fig. 59 shows the best methods in use. The advantage of mortise and tenon work is the easiness with which repairs can be effected, but it is a favorite lodging place for water and one of the first points to rot in a trestle—a drip hole partly obviates this; mortise and tenon work costs about $1 per M.B.M., more to frame than other methods shown. The drift bolt and dowel method is superior to the first one in rigidity, durability and easiness of erection, but is hard work to tear down, while the third method, although not in common use, appears to be a very sensible joint; the fourth method is for temporary work only, and is fastened with 6-inch pressed spike which would work loose very soon; it is an expensive and clumsy joint, but saves timber from mutilation for a second using. Probably the best combination is a tenon at the top of posts and 2 dowels 8 inches by 1 inch diameter at the bottom, such a system avoids rot and enables posts to be easily renewed and replaced.

(*e*) *High Trestles.*—When trestles are higher than 20 to 25 feet more than one story or deck will be needed (see Fig. 57), these may be either in separate bents locked by deck stringers, or they may be in a continuous bent in which the sill of one bent becomes the cap of the one below, etc.; in the former case the four lines of deck stringers, about 8 inches by 12 inches, overlap and are boxed onto the caps and sills and gained into them, giving a lock joint. The structure is very rigid, is simple of erection and easy to repair, but needs more material than the latter method, in which the longitudinal bracing consists of four lines of girts or wallings about 6 inches by 8 inches, which are butt-jointed and boxed about 3 inches on to the caps or posts and also bolted; this method saves one cap and some timber in the longitudinals also, and the upper and lower sway braces may be fastened by the same bolt at the cap-sill, but the trestle is a little harder to erect and much harder to repair, it is, however, on the whole probably the preferable method of the two.

(*f*) *Floor Systems of Trestles.*—The floor consists of stringers, ties and guard rails, and should be completed by adding some form of bridge guard like that shown on Fig. 60, by which trucks not too far off centre may be brought back to direction and probably placed again on the rails, or, at any rate, carried safely across the structure.

In Canada the wide-decked trestle, with two main

nests of stringers and two jack stringers supporting ties 12 feet to 14 feet long, is generally used on standard gauge roads, partly to give room for snowplows inside the guard rails and partly for additional safety; this is nowadays further supplemented by two lines of guard rails, of which the inner ones are faced with angle iron fastened by countersunk screws.

The sizes of guard rails and ties are shown in Figs. 61 to 65; but it is a growing feeling that ties cannot be spaced too close for safety to prevent bunching in case o derailment. They should not be more than 6 ins. apart clear at most and preferably 4 ins., and every fourth or fifth tie should be spiked to the stringers, and all boxed from ½ in. to 1 in. on to them. There are some, however, who claim that if ties are kept spaced by the guard rail, and are boxed down on to the stringers, that any further fastening is unnecessary; ties should be of oak or some durable hardwood, which will hold track spikes.

*Plate XVIII*

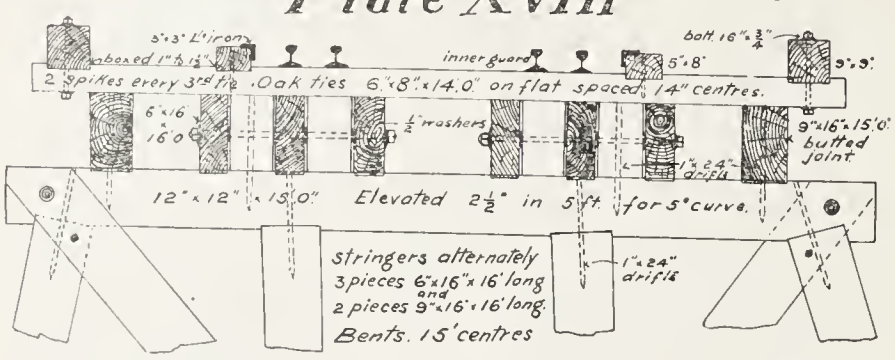



Fig. 61

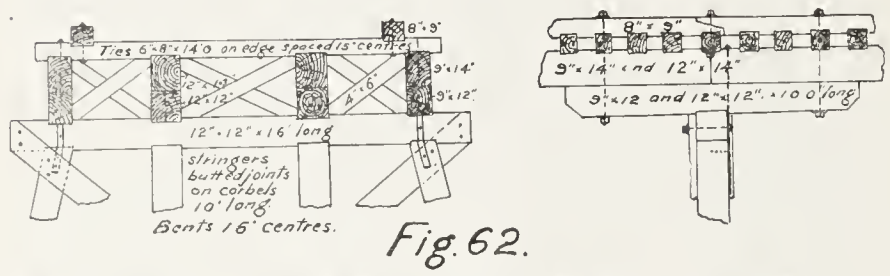



Fig. 62.

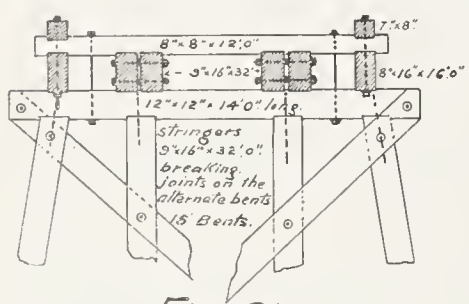



Fig. 63.

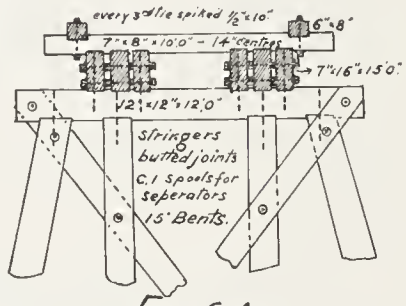



Fig. 64.

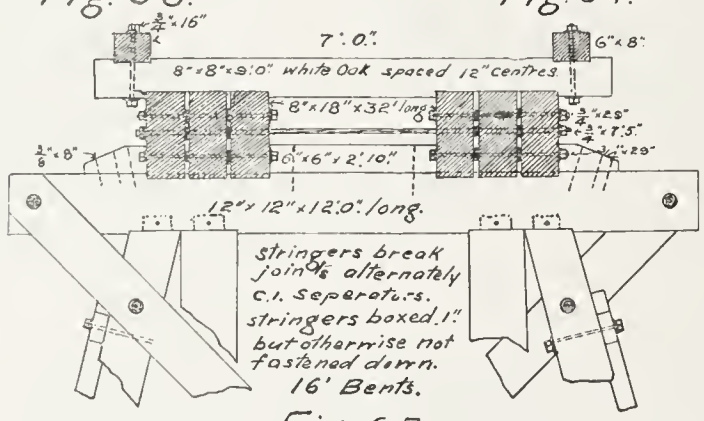



Fig. 65.

*Cross Sections of Trestle Floors.*

The guard rails should be of pine, or some durable wood that will not warp, and boxed down about 1½ inches on to the ties, so as to hold them apart, as well as to act as guard rails. They should be bolted on outer ones and spiked on inner ones to about every fifth tie. There are various styles of stringers; that shown on Fig. 61 is now almost standard for Canada. It consists of alternate groups of two and three stringers in two nests, one under each rail. These stringers are long enough to lap one foot and rest twelve inches on the caps, and are bolted together, but separated by cast washers to prevent rot, and each nest is drift bolted down to the caps. The outer or jack stringers carry very little of the load and are butt jointed, and also drift-bolted to the caps. The style shown in Fig. 62 is practically obsolete, being considered rather top heavy and demanding too heavy timbers; the corbels also give a very uncertain aid to the strength of the stringers. The style shown in Fig. 63 is used considerably in the United States. The stringers are 32 feet long, alternating with butt joints, and make a very stiff floor; but such large timbers are hard to obtain and harder to take in and out during renewals. One advantage, however, is that all ties will have the same boxings, while in Fig. 61, the length of boxing varies with each alternate bent—but the method of fastening the ties to the caps by long bolts is objectionable, such bolts will spring loose, and the heads would be cut off by the wheels of a derailed train. In the greater part of the United States, the narrow decked trestle, such as shown in Figs. 64 and 65 is very much used, there is an evident economy, the bents being narrower, the jack stringers omitted and only one guard rail, and that one close to the steel rails. It is claimed that such trestles with rerailing guards at each end, close spaced ties, and with an inside steel rail guard, are as safe as wider ones, and that a train which would derail so badly as to get outside the inner guards would leave the trestle anyway. Such floors are sometimes drift bolted down, or as in Fig. 65, held in place by a system of braces and rods—such a method having the advantage of facility of renewals.

(*g*) *Elevating Trestle Floors on Curves.* — This will amount to from a half-inch to five-eighths inch in five feet per degree of curve, and may be accomplished in various ways which are given in order of merit.

(1) Framing the bent with cap inclined to the required slope.

(2) Inserting an elevation or secondary cap on top of a level bent cap, and notching it down to suit the curve.

(3) Notching the main cap on light curves to receive the stringers.

(4) Placing blocks longitudinally under the ties and on top of the stringers.

(5) Sawing specially sloping ties.

(6) Placing strips or blocks under the steel rail but on top of the ties.

The sloping ties are, apparently desirable, but in renewals such a varied assortment is needed for trestles on various degrees of curve that it is an intolerable nuisance.

(*h*) The cost of trestle work is about as follows:

| | |
|---|---|
| Cast-iron washers, etc. | 2c. per lb. |
| Iron bolts, etc. | 5c. per lb. |
| Framing and erection | $6 per M.B.M. (drift bolted). |
| " " | $7 " " (mortise and tenon). |
| Cost of timber | $17 to $27 per M.B.M. |

A very ordinary price for timber now being $30 per M.B.M. in place, including iron; but in designing structures of this nature, by having due regard to the dimensions of timber which can be most readily obtained in any locality, the price may be held down, often somewhat lower than this, while sometimes a special price is put on stringers, which should be designed for the loads intended, and carefully inspected to see that they are up to the requirements, as they are the only members of the structure ever strained to their limit.

(*k*) *Quantities of Timber in Trestles.*—For very important and high structures, tables are of little value; but for ordinary use the following will give quite approximate quantities:—

TABLE XVI.

APPROXIMATE QUANTITY OF TIMBER IN TRESTLES PER 100 LINEAL FEET FOR VARIOUS HEIGHTS.

| Narrow Deck, Timbers 10 in. x 10 in. | | | Lake Erie and Western. | | Wide Deck, Timbers 12 in. x 12 in. | |
|---|---|---|---|---|---|---|
| Height. | F.B.M. | | Height. | F.B.M. | Height. | F.B M. |
| 15 feet | 17,000 | 1 story. | 17 feet | 19,400 | 10 feet | 25,700 |
| 25 " | 22,000 | | 22 " | 22,000 | 20 " | 30,500 |
| 35 " | 25,000 | | 27 " | 26,650 | 30 " | 38,600 |
| 45 " | 34 000, | 2 stories. | 32 " | 29,640 | 40 " | 47,000 |
| 55 " | 44,000 | | 37 " | 34,780 | 50 " | 55,200 |
| 65 " | 50,000 | 3 stories. | 42 " | 38,080 | | |
| 75 " | 56,000 | | 48 " | 43,920 | | |

## WILLIAM OGILVIE, THE CANADIAN EXPLORER.

William Ogilvie, Assistant Astronomer to the Dominion Government, was born in Ottawa, April 7th, 1846, when that city was known as Bytown, and before it had become the capital of Canada. In early life he had very slender opportunities of education. Apart from the fact that the family were not in affluent circumstances, his father, though a worthy and sturdy Presbyterian, had imbibed the idea that every boy should not merely be self-made, but self-made without school education. He had read in a favorite book of the Smiles' "Self Help" order, of a

The Lancefield Abell Co. Photo.

WILLIAM OGILVIE.

poor boy who could not afford a lamp at night, and studied with a borrowed book, standing under the light of a corner lamp, and he fancied that his son should go through the same process in order to achieve success in life. The mother, however, took a more sympathetic view of her son's difficulties and ambitions, and it was through her influence that the youth, when he made up his mind to become a surveyor, was given a chance to devote his whole time, for about three months, to home study to prepare himself for his future profession. He apprenticed himself to a local surveyor, and in spite of poor and insufficient text-books, and his service under a man who having obtained a surveyor's commission at a time when the standard of qualification was very low, had no literary instinct, and rather discouraged book learning in those under him, Mr. Ogilvie successfully passed his examination, and was commissioned as surveyor on the 12th July, 1869. From the proceeds of his own labors the young man was enabled to continue and extend his self-education, and the small local practice he obtained showed such intelligent and correct work that he attracted the notice of Surveyor-General Denis. At this time a number of long-standing disputes among landowners near Ottawa came to a head. There had been a good deal of vagueness in the law bearing on these cases, and the tangle was rendered worse by differences in the interpretation of the law between the officials of the Department and the Cabinet. Mr. Ogilvie, who had already been instrumental in settling a number of disputes between neighboring land owners for whom he had done professional work, was now called in by the Government, and his interpretation of the law was not only sustained by the Minister of Justice, but his plan for settling the disputes among the aggrieved farmers was accepted on both sides. In spite of jealousies and intrigues against him, the intelligence and sound judgment shown by Mr. Ogilvie in the cases in question resulted in his being called on in 1875 to do regular work for the Government, and in 1882 he began that career of exploration which has reflected honor on the Canadian nationality and placed his name in the very first rank of modern explorers. His first work was done in connecting the great Peace River region with the Dominion Land Survey system, which occupied the years 1882 and 1883. In 1884 he made an exploratory survey of the Athabasca and Peace rivers and in the following year he surveyed the Canadian Pacific Railway at British Columbia as a base line for the land surveys of the railway belt. In 1886 he was engaged on longitude work by electric telegraph. In the years 1887 and 1888 he made the exploratory survey of the Yukon, Porcupine and McKenzie Rivers which was to add so much to his fame by reason of the gold discoveries, of which, at that early date, he realized the value. In 1890 he was engaged in astronomical work in connection with the northern boundary of the Province of Quebec. In this expedition a canoe journey of 1,500 miles was made to James Bay and the East Main River, a great deal of valuable geographical information being added to our knowledge of these regions by Mr. Ogilvie, who at the same time carried on astronomical work by observations of the lunar culminations there. The importance of his geographical work in opening to the ken of the world new tracts of country of continental vastness became recognized in Great Britain as well as in Canada, and in the spring of 1891 he was awarded the Murchison medal of the Royal Geographical Society for having made the most important explorations in the world at that period; his services in surveying the Canadian North-West Territories being particularly mentioned in the award. In the same year he made an exploratory examination of the north-east portion of British Columbia, and in the following year was occupied with surveys around Prince Albert, Sask. In 1893 he was engaged on important work in connection with the delimitation of the international boundary line between Canada and Alaska, and this work, with the Taku expedition in Northern British Columbia in 1894-5, and the projection of the 141st meridian through the Yukon in 1896-7, gave him a wide knowledge, not only of the great alluvial gold fields of the Canadian Yukon, but of the conditions of life among the miners and traders, and a greater insight into the general resources of this great northern land than is possessed by any living man.

In these later expeditions, Mr. Ogilvie was called on to do all sorts of work for all sorts of people. If a miners'

dispute arose, he was appealed to as umpire; if any man was suffering wrong, he besought Ogilvie's aid in obtaining his rights. His decisions were accepted without dispute, and the secret of his influence throughou this time of gold madness was that his motives were above suspicion, his judgments always founded on common sense, and that he took no part in the universal grab for wealth. In all the wild excitement following the fabulous finds of gold, there was one man who kept his head and went on with his scientific work as if all the gold lying about him was accounted, like silver in the days of Solomon, of no more value than the stones of the street It is one of the admirable traits of this noble type of Canadian official that he has remained impregnable to the sinister suggestions of avarice though confronted with so many temptations; and one of the highest tributes paid him in this respect was by a New York paper, known for its anti-Canadian prejudices. A strong sidelight is thrown on this phase of his character by a British Columbia paper, which thus speaks of Mr. Ogilvie's relations to the miners.

"While admitting that the investment of three hundred dollars a few months ago in a grub stake for two men, taking in exchange a half interest in their claims, would have resulted in his being worth a million dollars to-day, Mr. Ogilvie modestly disclaimed any credit for refusing to invest, and it is almost certain that had he known at the time, beycnd any possibility of doubt, tha the investment of the $300 would have been as profitable as it has proved, his course of action would have been the same. 'I had to act up there as a sort of arbitrator, and I was not willing,' said he, 'to place myself in a position where my personal interests might have influenced my judgment." 'Regret it?' Mr. Ogilvie continued, 'no, not for a moment. As for money, I have plenty to satisfy me during my life, and I cannot take any away with me out of this world. As for my boys, they must work their way, as I have done, and they will be all the better men for it.'"

An interesting testimony to his perfect fairness to all the miners, irrespective of nationality, was recently given at San Francisco, when he was on his way home from the Yukon. A number of returned American miners sought him out and presented him with a valuable gold watch, in gratitude for his just administration of the affairs of he Klondyke.

A study of the accompanying portrait reveals a face indicative of great determination and administrative ability tempered with benevolence. We believe that Ogilvie is a greater explorer than H. M. Stanley. Without any of the harshness and arrogance that marked Stanley's methods, Ogilvie has, though not making any noise in a literary sense, accomplished greater work, and posterity will be brought to admit it.

In the twenty-two years during which he has been in the Government service he has traveled 75,000 miles by rail, 14,000 by steamer (mostly by the crude river crafts in use in the Canadian North-West), 8,500 by canoe, 9,500 on foot and 4,000 by cart or buckboard, making a total of 111,000 miles traversed on his official journeys. Difficulties such as Stanley and other travelers have depicted in dramatic colors have been passed over by Ogilvie without a word in his reports, and if the full story of his vast and lonely journey could be told it would make most valuable material for the future history of the great north land of Canada. It is very distasteful to him, however, to dwell on his own achievements, and it is only from his official reports, made as a matter of duty to the Government, that we can piece together some notion of his deeds. Once only did Mr. Ogilvie condescend to give a popular record of some of his work, and this was in the *Canadian Magazine*, for which he wrote a series of sketches under the heading of "Down the Yukon and up the McKenzie," and "In North-West Wilds," which appeared in 1893-4. The narrative of these remarkable travels is so simply told and yet so instructive and entertaining that all who have read them have wished for more. In one part of his first ketch he pauses in one of those days of 20 hours Arctic

WILLIAM OGILVIE, FROM PHOTOGRAPH TAKEN ABOUT 1889.

darkness to reflect "more than 2,500 miles were still lying between us and the nearest railway station, nearly all of which had to be got over on foot or by paddle"—a simple statement, but how eloquent of trial adventure, and enduring patience! In his sketch of the exploration of the great Mackenzie basin, he gives us a picture of daily life at Fort Nelson. One of the incidents is best told in his own words:

"There were two very old Indian women living at the Fort on such food as they got from the (Hudson Bay) Company's employees. One was totally blind, and the other nearly so. A half-witted Indian boy cut their wood and attended to their wants, and by way of compensation they shared their food with him. No one knew their age, but they had lived a long time for natives, as evidenced by their wrinkled faces, lustreless eyes, and toothless mouths. Their clothing was very scant and very dirty, their hut 'a thing of shreds and patches,' little better than none; their food was often scant, and their fire low. You fancy them utterly miserable, but they were not. I called on them daily with some food, a bit of tobacco, and a few lumps of sugar. This would put them into wonderful humor, especially the sugar. The blind one would hold her sugar in her hand, occasionally licking a lump, and exclaiming, 'Eh, Shugow,' (sugar) in a tone which bespoke complete ecstasy. The feast always wound up with a jocular discussion by these ancient dames as to which of them would secure me for their sweetheart. They invariably appealed to myself to decide between them, each meanwhile affecting all the airs of a pronounced flirt, displaying her charms with the most ludicrous poses, which convulsed me with laughter. The manner in which I parried these requests for a choice between them amused them highly, and who could refuse to brighten the lives of such poor old creatures with a little harmless pleasantry? Once the blind one, through the aid of the interpreter, told me her life story, how she had lost several husbands and all her children by death, had no friends alive that she knew of, and was waiting patiently

to join the lost ones in the Great Beyond. Her poor old wrinkled face and sightless eyes bespoke acute sorrow during the recital, especially when she expressed her desire to lay down the burden of her life. I have never elsewhere seen such squalid poverty accompanied by such childish cheerfulness."

This is an admirable bit of word painting, which, while it brings before us a vivid view of aboriginal life as it really is, to us reveals the tenderness and sympathy of the man.

One who knows Mr. Ogilvie intimately, gave the writer this estimate of his character: "He has a high sense of honor and strong judicial mind; careful practical generalship, enabling him to execute difficult undertakings and secure large results where most men would utterly fail; faithfulness to trust and scorn of anything underhand; energy and endurance, especially a capacity for protracted, constant labor. Add to these qualities his genuine good nature, his great knowledge of men and life, especially frontier life, and you have a man who is easily first among Canadian explorers, and I believe that only his modesty and disinclination to be 'boomed' has kept him from world-wide fame."

## SILVER IN THE OTTAWA VALLEY.*

On Calumet Island, in the Ottawa River, some research work was done last year on the deposits of blende and galena, noted there for some years, and mining licenses were granted on several lots. On lots IV½, N.W. 10 and 11, the old Russell property, Charles B. Watts and others, of Toronto, have prospected from the end of last winter, with 10 to 15 men; some work was done on this mine by the first proprietors, who established the presence of important deposits of blende and galena, an assay of which gave zinc, 40 per cent.; lead, 12 per cent.; silver, 15 ounces per ton. The actual works have brought to light new indications, especially on lot 10 near the line of 11, where at a depth of 45 feet a deposit of blende several feet thick can be followed for a distance of 80 feet, from which 200 tons were extracted, 50 of which are still at the mine. It was on lot 11, near the line of 12, that a deposit of galena was worked two years ago.

Charles Meyer and others, of Belgium, under the name of the Grand Calumet Mining Co., control the properties IV½ S. 9 ½, S. 10 and 12, and have prospected since spring with six or seven men. On lot IV., 12, in the vicinity of the pocket of galena above mentioned, they sank a trial shaft, which was not more than fifteen feet down in September. The surface indications show a band carrying blende and numerous specks of galena. The same company has also prospected on lots 9 and 10, where some blende was found. On 10, galena in fine grains is found in the diorite. I understand that if the prospects are satisfactory this company will arrange for the regular working of this mine, and will establish concentration works. It intends to work this winter with steam engines and drills. On the central part of lot IV., 9, Colin Campbell has cleared away the surface and laid bare a remarkable exposure of solid blende, with a width of 40 feet by 12. It is probable that this ore body has greater extension, as the rock has only been laid bare on this part, and the walls are not visible. In the southeast part of the same deposit there is also a fine indication of galena, of which a sample, taken by J. Obalski, and assayed, gave 103.82 ounces of silver and strong traces of gold, the whole representing $60 worth of precious metals. On lot 8 of the same range he also prospected and found indications of blende disseminated in the quartzite. He has worked since this summer with four men only.

The southern part of Calumet Island where these deposits are found, belongs to a strip of rock called the Upper Laurentian by the Geological Survey; the northern part is Laurentian. A mineral band seems to exist there, accompanying an eruption of diorite running in a N.N.W. direction, as shown by the croppings and rusty rocks, and by the few prospects above mentioned. The width of this band does not seem to be less than 200 to 300 feet, and it is claimed that indications have been found between lots IV, 8, and VII, 27, where the seam ores have been noted, thus giving a course of about four miles. The ore body is of blende, slightly mixed with galena, and carrying a percentage of silver to the extent of about 15 ounces to the ton. Occasionally, the galena occurs alone, as on lots IV, 8, 11, when its proportion of silver rises to 146 ounces per ton, according to assays which I caused to be made, and even more according to other assays; small threads of native silver are also found. It is impossible to say to what depths these deposits extend, but it is possible that the galena grows more abundant, when they would become profitable to work. The shipping points are at Clark Station and at Campbell Bay, on the Pontiac and Pacific Junction Railway, at six or eight miles from the mines. The ground is not very rough, is partly occupied by farmers and supplied with good roads. The Government still owns the mining rights of a portion of this territory, as well as the rights everywhere to the precious metals.

* Extracted from the report of J. Obalski, C.E., to the Commissioner of Colonization and Mines of the Province of Quebec.

## THE MOTOR CAR INDUSTRY.

The interview with Dr. Doolittle, which was published in the January issue of the ENGINEER, gives a very valuable outline of the present condition of the motor industry in Britain. None of the points he touched upon were elaborated, as the subject is such a many-sided one that it would require too much space. One criticism he made, however—namely, the exploitation of the industry by professional promoters for revenue purposes only—deserves fuller mention.

The Great Horseless Carriage Company, one of the off-shoots of the British Motor Syndicate, has been the victim of the most malign manipulation by promoters, and as a result its affairs are in a tangle. It is difficult to understand how level-headed Englishmen could have been wheedled into investing their money in a concern which had no business basis, the agreement upon which the company was formed having been so worded that it had no right to new patents issued since May, 1896. This means that, with their charter powers, the company must make carriages only from old patents that have been superseded; that it cannot make Daimler motors nor De Dion motors—these two being the most popular at the present time in Britain; nor can it make any cycle motors whatever. It is doubtful whether it can make a motor carriage to-day that would sell. In the course of litigation it has appeared that H. J. Lawson was the promoter and the sole acting director of the Great Horseless Carriage Company, and he had virtually also control over the British Motor Syndicate.

A committee of the Great Horseless Carriage shareholders has been formed to consider plans for the future of the company. Their report is lengthy and intricate, and need not be followed, except so far as it touches the main point dealt with in our interview in reference to the position of the motor car industry. For the purpose

of enquiring into the future of the industry some members of the committee went to Paris, where (never having been under government restrictions) the industry was making progress at the time prior to the passing of the English Act in Nov., 1896. They went through several large factories, each employing some hundreds of hands, and in most cases with order books full for many months ahead, and preparations for many large motors to increase the output. The principal motors in use were the Daimler, manufactured for vehicles by Panhard-Levassor & Peugeot, and the De Dion for tricycles, in which latter much business will certainly be done. A little attachment to their tricycles to hold two people is just out and becoming popular. It is also said that motor traction is being adapted to the French navy, postal service and army. The members of the committee returned quite satisfied with the progress and future of the industry in France. A visit was then paid to Coventry, where the Daimler Co. is now turning out several motors weekly; the Beeston Cycle Co. are making the De Dion tricycles, and the Humber Co. is starting with a regular output. Electric cabs are running satisfactorily in London, and a mail motor van is now undergoing long distance tests. In Scotland a line of motor cabs at Hamilton is working successfully, another at Blackpool, England, and cars are now under construction for two other lines to be opened in Scotland. There is of course a great deal of prejudice to contend with, but notwithstanding this the facts showed to the committee's satisfaction that the industry has come to stay; and the committee expresses the conviction that so soon as motor vehicles with all the latest improvements are turned out in quantity from the regular patents to enable them to be put on the market at reasonable prices, a motor manufacturing company will pay.

*For* THE CANADIAN ENGINEER.

## DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON.

*(Continued from last issue.)*

At Liverpool, Eng., the refuse destructors are of the Manlove, Alliott & Fryers slow combustion type, divided into cells (as the furnaces are called in England) about 2½ feet wide and 5 feet from front to rear. The refuse, which is of a very objectionable and filthy kind, is fed from the top, through holes at the rear end of furnace; the smoke and fumes from the fire are drawn off at the same place and pass over the damp, green refuse before entering the flues, for the purpose of drying the rubbish prior to arriving at the fire grate to be burnt. Only natural draught is applied by using a long chimney, and the temperature of the fires seldom exceeds 700° Fahr. On this ground the gases and fumes drawn off the fires must be cremated by passing them through a high temperature furnace, called a Jones' cremator, before being allowed to pass up the chimney to be discharged into the atmosphere. The weight of refuse, or garbage, which consists of mixed night soil, ashes, sweepings from paved streets, and house garbage, is reduced by 67 per cent. by the process of burning, yet the residue of clinker and ashes is not burnt sufficiently hard, and, therefore, of small value for ballast, etc. They have the same type of furnaces at Birkenhead, but have so altered the designs of the smoke flues that in place of being discharged at the rear end and the heat passing over the wet rubbish to assist in drying it, preparatory to being placed on the furnace, the fumes and gases are drawn out at the front near the clinkering door, with the object of compelling the fumes cast off by the roasting refuse to pass over the body of fire on its way to the collecting flues. This method partly consumes the poisonous gases. At Salford they also use the Manlove & Co. type, which they have so altered that they have increased the daily consumption of refuse by making a slight alteration in the feeding holes, and constructing their flues in a way that the flames and gases are collected and pass out at the centre of each cell or furnace, in place of being discharged at the rear or at the front end, as before explained. This method is stated by visitors and experts to be the most perfect low temperature, slow combustion furnace, working by natural draughts. But a great many of these furnaces are being made into high temperature furnaces of over 2,000° F., by applying forced draughts. Sometimes fans are used, but raw air is not the draught suited to burn rubbish, because the dry air forces part of the foul fumes forward past both the fire and combustion chambers, unburnt. When a mixed steam and air blower is used, the steam attracts and absorbs the poisonous fumes, and together with the heat of the furnace, destroys or purifies them, so that the gases can be freely discharged into the atmosphere without the aid of a fuel-burning cremator or a tall chimney.

By the slow combustion process, only seven tons can be burnt in 24 hours. When a strong forced draught is properly introduced with a few detail alterations, as much as 15 tons can be burnt in the same space of time, making a harder and better burnt clinker and ash, and reducing the weight of the residuum to about 25 per cent., while the low temperature process can only reduce it to 33 per cent. At the rural village of Withington, the destructors were built from their own surveyor's designs. They consist of six low temperature furnaces, a fume cremator, a chimney 150 feet high, engine, boiler, dynamo, motor mill, etc., the total cost being £3,400. At the bottom of the chimney stack double wire screens are fixed to prevent anything unburnt from being drawn up the chimney. At Cambridge they use Manlove's Destructors, and use the heat for generating steam that creates power sufficient to pump the town's sewage. They also have a dual system at Baildon. Their refuse destructor is of a slow combustion type, with a low temperature, so that the rubbish, ashes, night soil and garbage are only carbonized *and not burnt to an ash*. Each cell or furnace place is fed in at the rear of the fire bars, the rubbish sliding down an inclined plate from the tipping floor. The air or smoke pipes are carefully and mechanically adjusted in a way that the fire is almost smokeless, because loss of smoke means loss of carbon. They are fixed in the side walls near the front door, drawing sufficient to give the furnaces the right quantity of air to allow the refuse to carbonize, but not to burn sufficiently to make smoke. The residuum is a mixture of soft clinker, cinders and powdered charcoal, which are carbonized in this way under a patent for the purpose of using the residuum for a filtrate to purify the town's sewage, it being found to be the most suitable material. In this way Baildon cleans and purifies the town's sewage with the foul refuse, thus using one public nuisance to destroy another.

The Bradford corporation has the Manlove, Alliott & Co. furnaces, improved and altered to come up to the times, and as I before pointed out in the January issue, the fumes from the drying refuses pass over the fire, up through holes in the firebrick screen (which forms the arch over the fire) near the door, then through its own combustion chambers, passing along to the large collecting vault, thence through the flues to the steam boilers, from them through the economizers, afterwards finally passing out at the chimney. The combustion chambers and large vault

being always near a white heat, the gases from all the twenty furnaces get reburnt and well mixed together, causing a high temperature and an increase in the number of units of heat useful for steam raising purposes, proving that plenty of good brick work, well put together, scientifically arranged, so that it divides the particles and mixes the gases, expanding and increasing them, is a good investment because it largely assists in extracting all the injurious fumes from the discharged gases and nearly doubles the number of units of heat used for raising steam.

*(To be continued.)*

## CANADA HOLDS HER OWN.

The question of how best to reach the golden North has been decided by the Dominion Government, after consideration of the reports of engineers W. T. Jennings, Wm. Ogilvie, and others. The press of the United States has been most active in suggesting methods by which Canadians might be harrassed on their way to mine Canadian gold on Canadian lands. It has been found possible to make entry through United States ports troublesome and expensive—the people of Seattle and other western towns have thought that in this way they could capture the outfitting trade. The natural result has followed, and the Dominion Government has chartered a railway which will give us an all Canadian route to the Yukon country. Reference to the accompanying map of Alaska and the Yukon territory shows us the stretch of 150 miles between Telegraph Creek and Teslin Lake, which the McKenzie and Mann railway is to cover. The mouth of the Stikine River, as it is now officially known, is in the United States, but the free and uninterrupted navigation of the river, and every other on the coast, is guaranteed to British subjects by treaty.

metals produced from the lands alienated to the company, as compared with 10 per cent. imposed upon ordinary placer mining. The contractors are not to receive a cash subsidy, but, on the other hand, are required to put up a deposit of a quarter of a million of dollars as a guarantee for the execution of their contracts. No portion of the beds or of the banks for 25 feet on each side of high-water mark shall pass to the contractors under any selection of lands to be made under the agreement. The shores and all landing places, few and far between in that rugged, rock-ribbed country, and therefore very valuable, are withheld, and the free rights of passage and use along all navigable or floatable streams may not be impeded or obstructed by the company, and are absolutely reserved to the people. In case the contractors divert any stream from its natural channel, they must provide an equally convenient navigable or floatable channel in lieu. All mining claims held and recorded by free miners within any block of land selected by the contractors, shall be excepted from the grant, and shall not pass to the contractors. The tolls to be collected on the railway between Stikine River and

The details of the agreement between the Dominion Government and McKenzie & Mann, as given to the public, is summarized below: The agreement provides for the construction of a railway from the Stikine River, in British Columbia, near the mouth of Telegraph Creek, Glenora, or the mouth of the Clear Water River, northward to Teslin Lake, a distance of about 150 miles, thus giving connection with the Lewis or Yukon River, and an all-Canadian rail and steamboat route from a port on the Pacific coast to Dawson City. This road must be completed and in operation by September 1 next. The contractors must also construct a practical sleigh road from the mouth of the Stikine River to Teslin Lake, and provide suitable shelters and stopping places for travelers at intervals of not more than 25 miles along this road, and the road and shelters must be available for use not later than six weeks from now. The contractors must also provide steamboat transport of freight and passengers between Teslin Lake and Dawson City. The Government proposes to grant 25,000 acres a mile of mineral lands, or 3,750,000 acres in all, to the contractors. The lands shall be selected from the Klondyke provisional district, and from that part of the North-West Territories lying west of the Mackenzie River and Liard River and north of the 60th parallel of latitude. But it is provided that all arable land shall be reserved. It is also provided that in determining the selection of lands for the contractors, each alternate block shall be reserved for the Government. In addition a royalty of 1 per cent. will be laid upon all the precious

Teslin Lake will be first fixed by the Governor-General-in-Council, and, as so fixed, shall not be liable to reduction for four years. They shall then be reduced by 25 per cent., and after the road has been operated for seven years there shall be a reduction of 25 per cent. on the tolls as previously reduced, and after the road has been ten years in operation the tolls shall be subject to the general railway law of Canada in that behalf. The lands granted shall be free from taxation for ten years, except municipal taxation by an incorporated city, town or village within the Klondyke provisional district. When any ten continuous miles of the railway have been completed, the contractors may select 92,168 acres, or two blocks of land, and these blocks shall thereupon be reserved from sale or location, or free miners' claims, and on completion, from time to time, of any other ten miles, the contractors shall have the right to select two additional blocks, and on the completion of the railway, the blocks so reserved shall be granted to the contractors, with the exception of any existing free miners' claims, which shall be held inviolate. For five years from Sept. 1st, 1898, no line of railway shall be authorized by Parliament to be constructed from Lynn Canal, or from any point near the international boundary between Canada and Alaska into the Yukon, nor shall any aid in money or land be granted to any other contractors for this purpose. Moreover, during ten years from Sept. 1st, 1898, the contractors shall be given the preference in any aid the Government may see fit to grant towards the building of a line of railway from the Stikine River to an ocean port in British Columbia, provided they are willing to undertake the construction within a reasonable time.

## MACHINES.*

A machine is an instrument by means of which a force applied a one point is able to exert at some other point a force differing in direction and intensity. It has been usual in treating of simple machines to call the force applied power; but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of the applied force as the effort. The force exerted, or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body, as in stamping metal or dividing wood, or it may be friction, as in drawing a heavy body along a rough road. Besides the effective resistance, the effort is employed in overcoming the internal resistances, chiefly due to friction between the different parts of the machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be excess of what is necessary, or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest, it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess, the machine will be set in motion and continue to move with an accelerated motion. If the effort be too small, it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case, it is evident from the law of conservation of energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance, which we call simply resistance to the effort, is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome in the same time, or, in other words, is equal to the velocities of the points of application of the effort and resistance; or, if we take equal distances and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads: 1. A solid body movable around a fixed point; 2. A flexible string; 3. A hard inclined surface. Under No. 1 come machines acting on a lever, and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row boat, etc., the power is at one end, the fulcrum at the other, and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between. Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used, as in one block, the first one would support the whole weight, which we will say is 100 lbs.; the second pulley would support one-half of what is supported by the first, or 50 lbs.; the third would hold or support one-half of what is supported by the second, or 25 lbs. The force, therefore, required to lift the 100 lbs. would only be equal to 25 lbs., but, as it has been already said, what is gained in force is lost in time. No 3, inclined surfaces, including the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw the power and circumference equals the weight and distance between threads.

* A paper read before the Hamilton Branch, C.A.S.E., by Jas. Gill, teacher of Physics, in the Normal College and Collegiate Institute, Hamilton, Ont.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during December, 1896, 1897, and the twelve months to December, 1896-1897.

| | Month of Dec., | | Twelve months ending Dec., | |
|---|---|---|---|---|
| | 1896. | 1897. | 1896. | 1897. |
| Hardware and cutlery | £3,557 | £4,327 | £62,382 | £68,144 |
| Pig iron | 60 | 225 | 28,026 | 9,434 |
| Bar, etc. | 386 | 263 | 15,540 | 8,892 |
| Railroad | 36 | .. | 174,470 | 45,789 |
| Hoops, sheets, etc. | 2,473 | 112 | 49,435 | 77,935 |
| Galvanized sheets | 1 606 | 5,185 | 56,013 | 57,955 |
| Tin plates | 31,217 | 7,149 | 184,043 | 224,570 |
| Cast, wrought, etc., iron | 1,528 | 4,625 | 49,286 | 36,604 |
| Old (for re-manufacture) | .. | 170 | 15,758 | 7,854 |
| Steel | 3,001 | 3,946 | 88,394 | 55,902 |
| Lead | 1,777 | 978 | 18,128 | 28,370 |
| Tin, unwrought | 1,152 | 3,356 | 21,103 | 20,725 |
| Cement | 8 | 2,701 | 32,731 | 22,498 |

## TESTS OF CAST-IRON COLUMNS.*

We present herewith a report of the tests of full-sized cast-iron columns recently conducted by the Department of Buildings of New York city at the works of the Phœnix Bridge Co., Phœnixville, Pa., under the direction of W. W. Ewing, of the department. The tests began on Dec. 15th at 1 p.m., and were finished on December 21st. The machine used was the testing machine at the Phœnix works. To ensure the accuracy of the tests, the Building Department arranged a comparison of the Phœnix machine with the famous Emery machine in the United States Arsenal at Watertown, Mass. On December 30-31, 1896, a series of compression tests was made at Watertown upon a soft steel Phœnix column built by the Phœnix Iron Company especially for these tests. It was made of eight segments riveted together, forming a round column 21 feet long, inside diameter 14⅝ inches, thickness of metal 1⅛ inches, area of section 75 3 square inches, total weight of 5,485 lbs. The calculated safe load was 530 tons. The column was shipped to Watertown Arsenal and carefully tested in the Government machine shops at that place. Marks were made 26 inches from the ends, that is, 200 inches between marks, and a form of roller extensometer reading to 1-10,000 inches, was employed, to take all measurements. In applying the load constant increments were used. Certain additional loads were applied, corresponding with those to be applied later in the Phœnix machine. The column was then returned to Phœnixville, and the tests repeated in the Phœnix machine. The conditions were reproduced as nearly as possible; the same series of readings were taken, using the same extensometer. The results of the two tests are shown in Tables I. and II.

The gauge used to calibrate the Phœnix machine was a mercury column instrument, manufactured by Thomas Shaw, of Philadelphia, Pa., and numbered 5,447, was calibrated to read in pounds per square inch, and ranged from 0 to 220 lbs. The pressure used in the cylinder of the hydraulic testing machine is received on a diaphragm and transmitted to the lower end of the double-headed piston, whose upper end, of much greater diameter, is surmounted by another diaphragm, above which is a reservoir of mercury, and a mercury column of small bore. The actual tests were made with a higher reading mercury column which was compared with instrument No. 5,447 at the time of the tests, and afterwards by the maker of both instruments.

From the figures thus obtained the following computation of the calibration of the Phœnix testing machine was made and included in Mr Ewing's report:

Let $P$ = unit load in Watertown machine.
$l$ = compression in ins. due to $P$.
$P'$ = unit load in Phœnix machine.
$l'$ = compression in ins. due $P'$.
$P$ = 1 lb., $l$ = .0000000891, and $l'$ = .0002432916.
If $P : P' = 1 : l'$

$$\text{then } \frac{P}{P'} = \frac{l}{l'}, \text{ and } P' = \frac{P\,l'}{l}$$

$$P' = \frac{.0002432916}{.0000000891} = 2{,}730.54 \text{ lbs.}$$

* Reprinted from the *Engineering News*.

This figure indicates that each unit on the gauge must be multiplied by 2,730, to obtain the pressure exerted in lbs.

TABLE II.

COMPRESSION TESTS OF CAST-IRON COLUMNS MADE FOR THE DEPARTMENT OF BUILDINGS, NEW YORK CITY, IN 1896, BY GUS. C. HENNING, M. AM. SOC. M. E.

| No. | Length. | Outside diameter, inches. | Thickness. Maximum. | Thickness. Minimum. | Thickness. Average. | Breaking load, actual gauge-reading, lbs. | Sectional area, sq. inches. | Breaking load per sq. in. lbs. | *Corrected breaking load per sq. inch. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 147¾ inches. | 8 | 13-16 | ⅝ | ¾ | 520,000 | 17 08 | 30,400 | 25,840 |
| 2 | 150 " | 9 | 1⅛ | ¾ | 1 | 630,000 | 25 14 | 25,100 | 21,340 |
| 3 | 162 " | 12 | 1 | 1 | 1 | 1,250,000 | 34.55 | 36,200 | 30,770 |
| 4 | 159¾ " | 14 | 1⅛ | ¾ | 1 | 1,226,000 | 39.84 | 30,700 | 26,100 |

* The figures in this column are obtained by deducting 15 per cent. from those in the preceding column, for friction of the machine.

We come now to consider the results of the breaking tests of the cast iron columns. Ten columns were tested, six of them being 15 feet 10¼ inches long, 15 inches diameter, and from 1 to 1 3-16 inches thick; two were 13 feet 4 inches long, 8 inches diameter, and two were 10 feet long and 6 inches diameter. A condensed table of results, Table III., is given herewith, the last two columns of which are from our own calculations, and are not given in the Building Department report, which gives only the actual data obtained without drawing any conclusions.

From the observations reported by Mr. Ewing, we quote as follows:

Column 1—Column suddenly broke under a total load of 1,356,000 lbs. into 10 pieces; the fractured surface began about 3 feet 4 inches (average) from the bottom.

The quality of metal was medium grain; foundry dirt and blowholes were quite numerous; in one place the foundry dirt extended half way through the metal; in another place, there was a thin layer of foundry dirt and honey-comb midway between the inner and outer surfaces; between this layer and the two surfaces, the metal was perfectly sound: this layer of foundry dirt contributed to the weakness of the column, as was evident from an inspection of the fractured surface.

The column sheared at an angle of about 30° with an element of the surface, and about 45° with a normal to the surface, inside of the layer of foundry dirt, above referred to only. This layer of foundry dirt extended about 6 inches around (circumference) on column. At another fractured surface where no defects occurred, the metal sheared along a spiral course about 45° with an element of the surface, and at an angle of 45° with a normal to the surface; this surface was about 15 inches long.

Column 2.—The column crushed near the lower end, many of the pieces being quite small; the bottom flange was left intact, the fractured surface beginning at the top of the flange or 1¾ inches from the faced end of the column and extending around the shaft in an irregular manner, reaching 5 inches away from bottom flange in one place.

The shaft of the column above the fractured portion was found to be permanently sprung ½-inch in a distance of 9 feet 4 inches along shaft. The quality of metal at bottom of column, where fracture occurred, was medium grain and quite uniform in grain. Considerable quantities of foundry dirt was found at fractured surfaces and where the column crushed into small pieces, the foundry dirt extended all the way through in many spots.

The shaft sheared in several places at an angle of about 45° to the elements of the surface of the column parallel with its axis, the fractured surface following a sort of spiral path around the shaft. The metal at the same time sheared through at an angle of from 30° to 45°, with a normal to the surface of column.

Column B 2.—The fractured portion of column was below the centre, beginning 3 feet 9 inches from bottom and 6 feet 6 inches from top of column. Quality of metal rather course, but quite uniform. Flaws occurred in spots, but not bad. There was evidence of shear at 45°, the same as in preceding columns.

Column B 4.—The quality of metal was rather coarse in centre of shell, and somewhat finer toward the surfaces. Cinders and slag in considerable quantity, two bad spots nearly opposite at bottom of column where metal was poor; one of these was 5 inches long on outside (around column) and extending about half way through the metal On the opposite side the defective portion was 4 inches wide on inside, and extended for one-third to two-thirds the way through the metal. There were indications of shear at about 45°, similar to cases previously noted, at the bottom, where the column broke into

TABLE I.

RESULTS OF BREAKING TESTS OF CAST-IRON COLUMNS.

| Column No. | Length. | Outside diameter. | Thickness. Maximum. | Thickness. Least. | Thickness. Average. | Location of break. | Breaking load, lbs. | Compression. | Character of metal at fracture. | Sectional area. | Breaking load per sq. in. of area. lbs. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | 190¼ ins. | 15 ins. | 1 | 1 | 1 | About 3 ft. 4 ins. from bottom. | 1,356,000 | ..... | Medium grain; *a* blowholes and dirt. | 43.98 | 30,830 |
| II. | 190¼ ins. | 15 ins. | 1 5-16 | 1 | 1⅛ | Bet. 1 and 5 ins. from bottom. | 1,330,000 | ..... | Medium grain: *b* fairly uniform, spots of dry dirt. | 48.03 | 27,700 |
| B 2. | 190¼ ins. | 15 ins. | 1¼ | 1 | 1⅛ | Bet. 3¾ feet from bottom and 6½ ft. from top. | 1,198,000 | 2½ ins. bet. 150,000 and 1.108,000. | Coarse, but uni- *c* form; a few flaws. | 48.03 | 24,900 |
| B 4. | 190¼ ins. | 15⅛ ins. | 1 7-32 | 1 | 1⅛ | Betweeen bottom and one-third up from bottom. | 1,246,000 | 2¼ ins, bet. 150,000 and 1,246,000. | Coarse in centre; *d* finer on outside; cinders and slag. | 49.48 | 25,200 |
| 5. | 190¼ ins. | 15 ins. | 1 11-16 | 1 | 1 11-64 | At bottom flange. | 1,632,000 | 2 5-16 ins. in 8 ft. 3 ins. | Fine grain and *e* uniform where no flaws occur'd. | 50.84 | 32,100 |
| 6. | 190¼ ins. | 15 ins. | 1¼ | 1⅛ | 1 3-16 | No break; permanent set of 1 3-16 ins. in 8 feet. | Over 2,082,000 | ⅜-in. betw'n 232,000 and 1,108,000 | No break. *f* | 51.52 | Over 40,400 |
| XVI. | 160 ins. | Bet. 8¼ and 7¾ ins. | 1¼ | ⅝ | 1 | Where chaplet was placed at middle and at ends. | 651,000 | ..... | Metal g'd; me- *g* dium grain. | 21.99 | 31,900 |
| XVII. | 160 ins. | 8 ins. | 1 3-32 | 1 | 1 3-64 | At middle and ends. | 612,800 | ..... | Fine grain, uni- *h* form, and free from flaws. | 22.87 | 26,800 |
| 7. | 120 ins. | 6 1-16 ins. | 1 5-32 | 1⅛ | 1 9-64 | At middle and each end. | 400,000 | ..... | Good even grain, *i* no flaws. | 17.64 | 22,700 |
| 8. | 120 ins. | 6 3-32 ins. | 1⅛ | 1 1-16 | 1 7-64 | At middle and each end. | 455,200 | ..... | Fine grain, uni- *j* form, and free from flaws. | 17.37 | 26,300 |

REMARKS.—*a*. One place, foundry dirt extended half way through; another place, foundry dirt and honeycomb between inner and outer surface.

*b*. At a pressure of 1,302,000 a slip of some kind occurred, which dropped the pressure to 1,275,000; again run up until break occurred. Upper portion sprung ½-inch in 9 feet 4 inches.

*c*. At 1,108,000 column sprung badly; movement recorded under compression.

*d*. Bad spots, cinder pockets and blowholes near middle of column; small cracks in necking near top; column given a permanent set.

*e*. Flaws and foundry dirt at point of break; load was carried as high as 1,803,000. The dummy head against which column rested was found broken after the test; this may have had something to to do with character of break.

*f*. Pressure run up to 1,108,000 and released. It was again run up to 2,082,000, released and run up to 2,033,000. Column could not be broken; capacity machine reached.

*g*. At time of breaking, column had a vertical deflection of 3 9-16 inches and a horizontal deflection of 1⅛ inches; fracture seemed due to flexure.

*h*. Vertical deflection, 4¼ inches; horizontal, 7-32 inches.

*i*. Vertical deflection, 3¼ inches; horizontal deflection, 1 11-32 inches.

*j*. Vertical deflection, 3 inches; horizontal deflection, ⅞ inch.

small pieces, The total number of pieces was 15. The fractured surface revealed many cinder pocket and blowholes near middle of column. Small cracks were observed in the necking near top of column.

Column 5.—Column broke into 14 pieces; all fractures occurred below the lower necking on column and broke through bottom flange. The permanent set in the shaft between the upper and lower necking was $2\frac{5}{16}$ ins. in 8 ft. 3 ins.; the upper part of the shaft above the necking remained perfectly straight after the test. Flaws were found in fractured surfaces near bottom, of foundry dirt. One bad flaw about 5 ins. wide and 4 ins. high (long) on outside, extending three-fifths of the way through. Quality of metal was rather fine grain and very uniform where no flaws occurred. Part of the shaft remained intact to end, and part of flange was left on. After the test, it was found that a dummy head against which the end of the column bore, was broken in such a way that the load on the column was eccentric after the head gave out; the nature of the fracture sustains this belief.

Column 6.—The test was discontinued when a load of 2,033,000 lbs. had been reached, the capacity of the machine having been reached. The permanent set of the column after it was removed from the testing machine was $\frac{13}{16}$-in. in a length of 8 feet 5 ins. The concave side, after the test, was about 90° from tbe joints of the flack, and undoubtedly was the top of the column as cast in the mold.

Column XVI.—One fracture occurred at a point where the chaplet for holding down the core was imbedded into the metal of the column. the metal outside of the chaplet was $\frac{7}{8}$-inch thick, and the chaplet 3-16-inch metal. The cast metal did not adhere to the chaplet. The column broke into six pieces (at middle and at each end). The fracture at the middle was nearly square off, and very near the exact middle point between the two ends. The fractures were about one foot from each end and irregular in outline. The metal was good, of medium grain. Wires were attached to the shaft of the column, 6 feet 6 inches from bottom, and ran perpendicular to the axis of the column, one horizontally and one vertically. These were carried to the outside of the building in which the tests were being made, and the actual vertical and horizontal deflections of the column were observed in conjunction with the corresponding loads. There was no evidence of shear at the fractured surfaces, as in the case of the larger columns. Failure seemed to result primarily from flexure.

Column XVII.—The column broke into eight pieces, the fractured points being at the middle and near each end. Quality of metal at fractured surfaces was fine grain, uniform and free from flaws.

Column 7 was broken into four pieces, the fractures being 3 inches to one side of the middle of the column and near each end. The quality of the metal was good, even medium grain, with no flaws.

Column 8.—The quality of metal was fine grain, uniform and free from flaws. The column broke into four pieces, fractures being at middle and near ends; broke off nearly square at each point; no signs of shear in metal.

Two of the 15-inch columns tested, Nos. B 2 and B 4, were taken from the Ireland Building, which it will be remembered, collapsed August 8th, 1895. The four remaining 15-inch columns were made from drawings prepared by the Department of buildings of New York city, and were as nearly as possible duplicates of the Ireland columns.

The columns marked I. and II. were made by the Jackson Iron Works, New York city, of their ordinary run of metal. They were cast while other columns were being cast, with no knowledge of their ultimate use. The two marked 5 and 6 were made by the Healy Iron Works, Brooklyn, N.Y., who were informed of what the columns were wanted for. The drawings for the 6-inch and 8-inch columns were also made by the department.

All the columns broken were, we understand, fair samples of the ast-iron column used in buildings in New York city, and regularly passed by the Building Department as coming within the provisions of the law.

The building law of the city of New York says:

"The strength of all columns and posts shall be computed according to Gordon's formulæ, and the crushing weights in pounds, to the square inch of section, for following materials, shall be taken as the co-efficient in said formulæ, namely: Cast-iron, 80,000. . . . The factors of safety shall be as one to four for all posts, columns and other vertical supports when of wrought-iron or rolled steel, and as one to five for other materials, subject to a compressive strain."

Applying Gordon's formula* with the co-efficient 80,000, as above required, in the numerator, and 400 (which is not given in the law, but is given in Haswell's Pocket Book, to which reference is made) in the denominator, we have

$$S = A \frac{80{,}000}{1 + \frac{l^2}{400\,d^2}}$$

* Mechanics' and Engineers' Pocket Book, Chas. H. Haswell, 1897, p. 768.

in which S is the breaking load, A = sectional area in sq. ins., l = length, and d = diameter of the column in inches.

For the 15-in. columns we have l = 190 ins., d = 15 ins., S = 57,143 A. For the 8-in. columns, l = 160 ins., d = 8 ins., S = 40,000 A. For the 6 in. columns, l = 120 ins., d = 6 ins., S = 40,000 A. That is, by the New York law, the 15-in. columns would be calculated to have a breaking strength of 57,143 lbs. per sq. in., while the actual tests show that their strength was only from 24,900 lbs. to something over 40,400 lbs. per sq. in. The 6 and 8-in. columns would be calculated to have a breaking strength of 40,000 lbs. per sq. in., while their actual breaking strength was only from 22,700 to 31,900 lbs. If such columns as these are loaded in buildings with the loads which the law allows, the factor of safety, instead of being 5, as required in the law, is actually in some cases more than 2. This is also borne out by the results obtained during similar tests conducted about a year ago by the Department of Buildings with full-sized cast-iron columns. The dimensions and results of these tests are given in Table IV. The values given in the column headed "Breaking load" are in round numbers, hence the breaking loads per square inch of area are correct to the hundreds as given.

## A NEW ACETYLENE GAS GENERATOR.

The Hamilton Acetylene Gas Machine Co. having acquired the rights of a new acetylene gas generator invented in Welland, has established a factory at 228 King Street East, Hamilton, where it is now turning out large numbers of the machines, for which there is an active and growing demand.

A rough sketch of this machine is presented herewith. The water for feeding the carbide is taken into a tank above the gas holder, and this tank is kept full by means of a ball-cock attachment such as is used in a water closet tank. From here the water is fed to the car-

bide chamber shown to the left of the foot of the gas-holder. The holder is much the same in principle as a coal gas holder, and has the usual water-seal. As the gas is exhausted from the holder, a small bar which projects over the edge of the roof of the holder, catches the arm of a lever valve, and as it descends the valve is opened and the water starts to flow from the upper tank through a rubber pipe into the carbide chamber. The jet of water does not fall in one spot on the carbide, but is distributed over the material in a spray on all sides from a nozzle. When gas is thus generated by the water, the acetylene fills the holder, but when full the excess of pressure is relieved either by the top of the holder striking a spring valve and so

opening an outlet to the waste gas pipe which leads outside the building; or by an internal pipe, the lower end of which is lifted above the water-seal before the holder is full to excess. Two small cocks at the bottom of the holder let off the water that may gather from condensation; and when the carbide chamber needs re-charging a cock is turned in the gas supply pipe to prevent the gas from returning out of the holder. The carbide is held in the chamber by a wire cage in which receptacle it may be agitated by a shaker which can be operated by an outside handle.

The following are the special claims put forth for this machine by its manufacturers: (1) It is perfectly automatic in its action, and makes gas equal to the consumption only. This they claim above all other machines that are in the market. (2) It is not dependent upon the gas pressure to regulate the supply of water to the carbide, consequently the pressure upon all parts of the machine is at all times equal and does not exceed the amount necessary to supply the burners, viz., one and one-quarter ounces per square inch; it is therefore absolutely safe. (3) It mechanically regulates the quantity of water that is from time to time automatically brought in contact with the carbide, as the consumption requires, so that gas cannot be generated beyond the capacity of the machine. (4) The generator is so constructed that the carbide can be added and the ashes instantly removed without loss of gas, without shovelling any ashes, and without unscrewing any parts of the generator with a wrench or otherwise. All we have to do is to lift the cover off the generator and lift out the vessel and dump contents, then re-charge with carbide. Joints are all water joints. We challenge any other machine on these points. (5) A generator holding from 30 to 50 pounds of carbide will supply gas for a large dwelling house or store sufficient to last two or three weeks, and will require little, if any, attention.

The company is in possession of a number of very gratifying testimonials from users of the machines, and claims to have the cheapest machine in the market.

The president of the company is Dr. George S. Bingham, and the secretary, A. J. Seguin.

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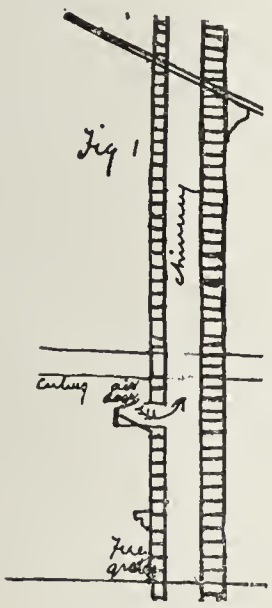
*For* The Canadian Engineer.

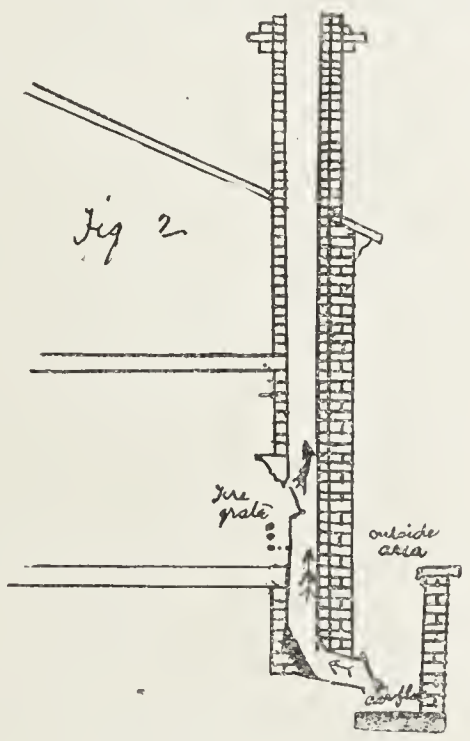
## DOWN DRAUGHT IN DOMESTIC CHIMNEYS.

BY W. M. WATSON, TORONTO.

In answer to your query—what will prevent cold air passing down the chimney into your parlor, through the open fire-grate? I may first state the reasons for air doing so, are, because the room is of higher temperature than the outside atmosphere, or even the air contained in the chimney shaft, and the brick work forming the inner

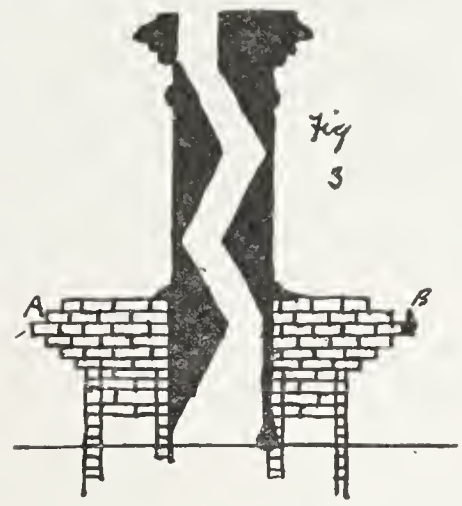



DOWM DRAUGHT.



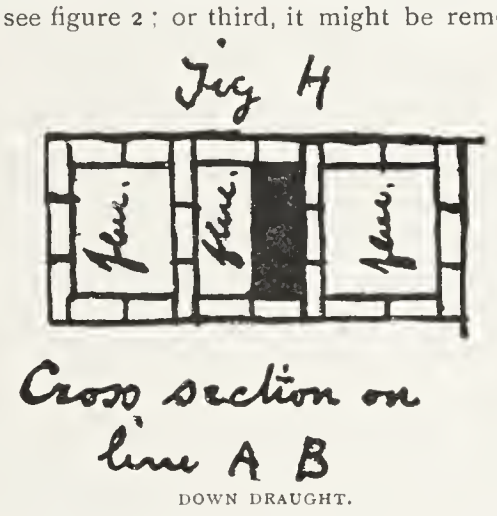

DOWN DRAUGHT.

wall of the shaft. Second, because probably your chimney is built straight and vertical from your grate to the head of the flue, without having any proper bend or goose neck offset, to prevent weight of the heavy, cold, outside air from passing down the full length of the chimney; thus providing an easy route for the outside atmosphere to secure heat by entering and mixing with the air of the parlor. You might possibly prevent it by ventilating your room near the ceiling, through and into the offending flue. This would cool your room, but supply warmth to the inner brickwork of the flue and its contents of air. Your opening, if you adopt that plan, should have the mouth or opening looking up towards the ceiling. If your flue extends down to the basement or cellar where the air is near the same temperature as the air above the roof, then you can stop the nuisance by making an opening that will circulate the air from the cold basement to the housetop by way of the chimney flue, causing always an upward current through the shaft. By fitting proper doors, when a fire is needed in




DOWN DRAUGHT.

the parlor, the door at end of flue in basement or outside can be closed, and the one behind the fire grate opened and again reversed when no fire is needed, see figure 2; or third, it might be remedied by making




DOWN DRAUGHT.

a chimney top of galvanized sheet iron similar to sketch 3 and 4 with a bent flue, to take the weight and pressure of the heavy outside air, and act in place of the goose-neck or offset, that should always be constructed near the head of every chimney-flue serving a dwelling-house.

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## CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Canadian Society of Civil Engineers was held in Montreal, January 11th. The first business was the election of scrutineers. J. W. Heckman, T. W. Lesage and James Ewing were elected scrutineers of the ballot for the election of officers and members of council; H. B. Stuart and W. G. Matheson, of the ballot for the nominating committee; F. L. Somerville, J. S. Vinden and L. G. Papineau, of the ballot for amendment and by-laws, proposed by members, and J. W. McCarthy, L. J. Maven, and L. A. Amos, for the ballot for amendment to by-laws proposed by the council.

The meeting was then adjourned in order that the members might avail themselves of the invitation of the Royal Electric Co. and the Chambly Power Co., to visit the works, now nearly complete, at Chambly, Que. The Grand Trunk and Vermont Central railways provided a special train, and upwards of 130 members of the society took part in the excursion. On their arrival they were received by S. T. Willet, president of the Chambly Co., and Senator Thibaudeau, president, and W. H. Browne, general manager, of the Royal Electric Co. It is unnecessary to add anything to the illustrated description of this plant in our December number, except that the visiting engineers expressed their high approval of the work, and their sense of its commercial importance. After the inspection luncheon was served in the switchboard chamber, where speeches were made by the Mayor of Chambly, S. T. Willet, G. H. Duggan, Senator Thibaudeau, W. H. Browne, P. St. George, J. A. L. Strathy, and W. McLea Walbank. While at Chambly some of the visitors took the opportunity to visit the old fort built by Mons. de Chambly, in 1711. On the return journey to Montreal, the train was stopped at the Victoria Bridge, so that the members might have an opportunity of inspecting the superstructure in process of erection there. In the evening, the annual banquet was held at Windsor Hotel and was largely attended. C. E. W. Dodwell, of Halifax, acted as toast master, and his genial originality and ready wit contributed much towards making the dinner, what it certainly was, the most successful and enjoyable one ever held. The adjourned meeting was resumed at about 10.30 a.m., on Wednesday. In the

absence of T. C. Keefer, C.M.G., President, and Messrs. Jennings and Thompson, vice-presidents, G. H. Duggan occupied the chair. The secretary, Prof. C. H. McLeod, read the report of the Council for 1897, which was as follows :

ROLL OF THE SOCIETY.

The elections comprised eight members, fourteen associate members, one associate, and fourteen students. Ten associate members have been transferred to the class of members, and four students to the class of associate member. Resignations have been received from two members, one associate and one student. The deaths have been:

Members—Alan MacDougall, H. F. Perley and D. A. Stewart.

Associate members—James R. Peddar and H. L. Langevin.

Associate—John H. R. Molson.

At present the membership stands as follows:

| | Non Res. | Res. | Total. |
|---|---|---|---|
| Honorary members | 6 | 2 | 8 |
| Members | 231 | 53 | 284 |
| Associate members | 115 | 30 | 145 |
| Associates | 28 | 13 | 41 |
| Students | 99 | 35 | 134 |
| Total | | | 628 |

At the same date last year:

| | Non Res. | Res. | Total. |
|---|---|---|---|
| Honorary members | 6 | 2 | 8 |
| Members | 218 | 53 | 271 |
| Associate members | 115 | 30 | 145 |
| Associates | 27 | 15 | 42 |
| Students | 94 | 31 | 125 |
| Total | | | 591 |

It will be seen that the number of members, associate members and students, i.e., the active membership of the society, has increased during the year. The total increase in the membership of all classes is thirty-seven. At the time of the last annual general meeting there were eight new applications, and at the present time there are nine applications for admission into the society.

The eleventh annual meeting was called to order at 10 o'clock a.m. Tuesday, Jan. 12th, 1897, Herbert Wallis, president, in the chair. Fifteen ordinary meetings were held during the year, at which the following papers were read : A New and Cheap Method of Dressing Car Wheels, by R. Atkinson, M. Can.Soc. C.E.; Fraser Valley Reclamation, by R. E. Palmer, Assoc. M. Can. Soc. C.E.; The Old Albion Mines Railway, by the late D. A. Stewart, M. Can. Soc. C.E.; The Separate System of Sewerage in Ontario, by Willis Chipman, M. Can. Soc. C.E.; Fortifications, by C. R. F. Coutlee, Assoc.-M. Soc. C.E.; Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce, by Prof. H. T. Bovey, LL.D., M. Can. Soc. C.E.; Sewage by Subsoil Irrigation, by E. Mohun, M. Can. Soc. C.E.; Impulse Water Wheels, by J. T. Farmer, student Can. Soc. C.E. Abstracts have also been read on the following subjects: 1. Water Power, its Generation and Transmission; 2. Water Power of Caratunk Falls; 3. The Transverse Strength of Beams; 4. The Underpinning of Heavy Buildings; 5. Methods and Results of Stadia Surveying; 6. The Liverpool Water Works; 7. Relative Tests of Cast Iron and Strength of Cast Iron; 8. The New Water Scoop of the Pennsylvania Railway; 9. Water Power and Compressed Air Transmission Plant for the North Star Mining Co.; 10. Foundations of Tall Buildings; 11. Solar Work in Surveying; 12. Through Barren Lands; 13. Comparative Tests of Steam Boilers with Different Kinds of Coal; 14. Paint as a Protection for Iron; 15. Inclined-Plane Railways; 16. 100 Feet Standard of Length of Boston Water Works; 17. The Manufacture and use of Sand Cement; 18. Some Experiments on the Condensation of Steam; 19. An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing. A series of lectures on the "Transmission of Power by Compressed Air, Gas and Steam," by Prof. J. T. Nicolson, B.Sc., M. Can. Soc. C.E., and Prof. R. J. Durley, B.Sc., Assoc.M.Can.Soc.C.E., were delivered during February and March of this year. The lectures were illustrated by lantern projection, and attracted very large audiences. They are now published in condensed form in Vol. XI., Part I., and constitute a valuable contribution to the published transactions of the society. An illustrated lecture on "Cantilever Bridges," by Mr. J. A. L. Waddell, Ma. E., bridge engineer, of Kansas City, Mo., was delivered at the meeting of October 28th.

The accommodation of the society has been enlarged during the year. The council at its first meeting appointed a committee on Dominion Legislation, but the committee has not deemed the time opportune to take any action. The several provincial committees on legislation, as constituted last year, were re-appointed. During the year additions have been made to these committees owing to the death of two of the members and the resignation of others. The committees are now constituted as follows: Nova Scotia—M. Murphy, C. E. W. Dodwell, W. R. Butler, W. G. Matheson and H. S. Poole. New Brunswick—P. S. Archibald and Hurd Peters. Quebec—St. George Boswell, L. A. Vallee and E. Marceau. Ontario—W. T. Jennings, M. J. Butler, Willis Chipman and W. G. Thompson. Manitoba—H. N. Ruttan, G. H. Webster and J. Woodman. N.-W. Provinces—W. D. Barclay, G. A. Stewart and W. I. Thompson. British Columbia—G. A. Keefer, H. J. Cambie, A. J. Hill, H. Abbott and F. C. Gamble.

In October the council appointed H. Wallis, W. J. Sproule and C. H. McLeod, a special Central Committee on Legislation with power to add to its number H. Irwin has been added to the committee. Since its appointment this committee has, in conference with the Quebec Provincial Committee, given a large amount of time to the promotion of legislation in Quebec. In Nova Scotia the Provincial Act was, in January last, passed through the Lower House, but consideration of it was deferred in the Legislative Council, and it will be necessary to reintroduce the bill during the session which will open some time in January.

At the first meeting of Council W. J. Sproule resigned, and his place was filled by the appointment of E. Marceau. On June 8th C. H. Rust was appointed a member of council to fill the place made vacant by the death of Alan MacDougall. On October 12th G. H. Duggan was appointed a vice-president in the place of Prof. H. T. Bovey, resigned, and W. J. Sproule was elected to the council to replace G. H. Duggan.

Signed. T. C. KEEFER, President.
C. H. MCLEOD, Sec'y.

This, together with the treasurer's report, and that of the Library Committee, was adopted. Some discussion on the arrears in subscriptions followed the treasurer's report, motions were made and withdrawn, and finally the council was left to use its own discretion in individual cases as formerly. K. W. Blackwell, the treasurer, referring to the legacy of $500 left by the late H. G. C. Ketchum, said that the council felt it had no power to dispose of it, and thought that the meeting might specify the purpose to which it was to be devoted. Herbert Wallis, in reporting progress on behalf of the Committee on Legislation, said that after a great expenditure of time and energy in Quebec, the Close Corporation bill had passed and, notwithstanding some alterations, the bill was now substantially in the form they had labored for all along. This scheme is not a selfish thing. It will benefit those who come after us, said Mr. Wallis, by materially raising the status of civil engineers. Our secretary (Prof. C. H. McLeod), has labored splendidly, and our connection with McGill University has been of undoubted value. Nor must we forget the great credit due to Messrs. Marceau, Boswell, Vallee, Irwin and Sproule. The bill awaits only the sanction of the Lieutenant-Governor to become law. He heartily congratulated the society. Some desultory remarks followed on the subject of the bill, and the secretary announced that some copies of it had been printed, and could be seen at any time by members of the society. The chairman, G. H. Duggan, said he thought the incoming council would like some instructions how to proceed in other matters connected with legislation.

The chairman then called on Prof. Butler for his report on standard measures. The secretary then asked simply that the powers of this committee be continued. The report of the Committee on the Gzowski Medal was received. It recommended that the medal be awarded to Prof. S. L. Fortier, B.Sc., Montreal, for his paper on "The Storage of Water in Earthen Reservoirs."

W. J. Sproule then proposed the following resolution : "That it is in the interests of the engineering profession that the method of doing professional work, for giving advice, for a remuneration estimated by a percentage of the cost of the work to be constructed, is not in the best interests of the profession, nor for the clients of engineers; that its tendency is

immoral, and that this method should be discontinued as soon as possible; and that the attention of all the members be directed in a special manner to this resolution." He said: This is a big question, I know, but not new to many engineers. I believe that the practice is wrong in every respect. That the engineer should be influenced by the idea that the more he makes the work cost, the more comes into his pocket, is only human after all. I do not pretend by any means that all are influenced by mercenary motives, but since the way is open, it is not surprising that weak individuals sometimes fall into such a natural trap. In the case of many small muncipalities where possibly some member cannot even read or write (and there are such), what would be the effect of such a known fact on a designing engineer? This motion was opposed in a fluent and vigorous speech by J. M. McCarthy, who said that such enormities as Mr. Sproule wished to render impossible were no more common in the civil engineering profession than in any other, and might be left to work their own punishment from the popular judgment. He gave some pertinent reasons why the present method should continue to govern professional services. The motion, which was seconded by F. F. Miller, was lost on division.

The scrutineers of the ballot for amendments to by-laws announced the result of the ballot for the amendments proposed by the council. Article 28 was the first attacked. It is as follows: There shall be a council, consisting of the president, vice-president, treasurer, secretary, honorary councillors and councillors, and of this council five shall constitute a quorum. The members of council shall retain their position until their successors have been appointed. It was proposed to leave out the word "secretary" in the second line, and to add to the article "the secretary to be appointed by the council." Lost. Article 35 was the second. It provides that the nominating committee shall draw up a list of voting members qualified to fill the various offices, specifying that of secretary amongst the others, the entire list to consist of 34 names. It was proposed to leave out the word "secretary" and exclude that position from the list of councillors. Lost. Article 19 was the third. This provides that each student shall pay $2 per annum. It was proposed to amend this so that each non-resident student should pay $2 and each resident student $3 per annum. Lost. The fourth proposal was for a new by-law, as follows: Every new member as associate member shall upon admission to the society, pay a fee of $20, but no additional payment other than the increased annual subscription shall be due from an associate member upon his transfer to membership, which was adopted.

The amendments proposed by the members were all carried. The first referred to by-law No. 27, which is: The officers of the society shall consist of a president, three vice-presidents, a treasurer, a secretary, a librarian; the past presidents, who shall be styled honorary councillors; and fifteen councillors. Of the fifteen councillors, not more than three may be associate members. The words "last three surviving" are to be inserted before the words "past presidents," and the words "who continue to be members," inserted immediately after the words "past presidents." Article 34 provides for the appointment by the council of committees of five each on finance and the library, without regard to the number which shall form a quorum on each committee. The amendment is that three shall form a quorum. By-law No. 35 is amended to agree with the amendments to No. 27, and will be as follows:

"A nominating committee of eight voting members elected annually and of the last three surviving presidents, who continue to be members, shall draw up a list of names of such voting members as in its opinion are qualified to fill the offices of president, vice-presidents, treasurer, secretary, librarian, and councillors for the ensuing year, and who shall previously to their names being entered upon the list, have signified to the committee in writing their willingness to accept their several nominations."

H. Irwin said that from time to time outside members had complained that they were not represented on the council. This ought to be remedied. Members all over the country should send in a list of those whom they thought ought to be on the committee It is very difficult for the local committee to choose. H. Peters thought that there might be some difficulty about this. Still, while all acknowledge the rights of Montreal, other societies move their annual meetings from place to place. Would it not be desirable for the civil engineers? It would undoubtedly extend their influence. He gave notice that at the next annual meeting he would move that the annual meetings be held in different places. W. J. Sproule thought that this object would be sufficiently met by a summer convention, one of which had been held. An important consideration is that all the records of the society are in Montreal.

The scrutineers then announced the result of the ballot for the election of officers, which resulted as follows: President, W. G. McN. Thompson, of St. Catharines; Vice-Presidents, K. W. Blackwell, P. W. St. George, H. D. Lumsden; Secretary, Prof. C. H. McLeod; Treasurer, H. Irwin.

Members of Council—H. N. Ruttan, Duncan McPherson, C. E. W. Dodwell, G. H. Duggan, E. H. Keating, St. George Boswell, J. H. Shanley, C. B. Smith, J. D. Barnett, F. C. Gamble, J. Galbraith, Hurd Peters, W. McLea Walbank, J. L. N. Coste.

P. W. St. George expressed the thanks of Mr. Thompson, who was unavoidably absent, and also his own for election to their respective honors. The secretary then announced that the retiring president, T. C. Keefer, C.M.C., had sent an address on "The Progress of Engineering Works during the last ten years, and of Water Works in particular." This was read by C. S. W. Dodwell, and will be found reported upon another page.

In proposing a vote of thanks, Jno Kennedy said: "I have much pleasure in proposing a vote of thanks to our president, Mr. Keefer, whose absence we all regret very much. We owe him a great deal. The society honored itself as well as Mr. Keefer in electing him as president for the second time, and much of the success of the society to-day is due to his kind interest in it during the past ten years. Mr. Keefer has been honored by our Queen and by his profession, and I am sure I am speaking for every individual member, not only of the society, but of the profession at large, when I say that all the honor and more is due to him. I say again, therefore, that it gives me great pleasure to propose a vote of thanks to Mr. Keefer for his very interesting address just read, and for his services as president of our society. This was seconded by H. Peters and carried by a standing vote. The meeting terminated with votes of thanks to the Royal Electric Co. at Chambly, the G.T. and C.V. railways, the scrutineers, the Hon. Messrs. Attwater, Duffy, and the other gentlemen who assisted in passing the Close Corporation bill at Quebec, to Prof. C. H. McLeod for his valuable services in the same direction, to the treasurer, K. W. Blackwell, to the St. Lawrence Cement Co., and to the curator of the fort at Chambly.

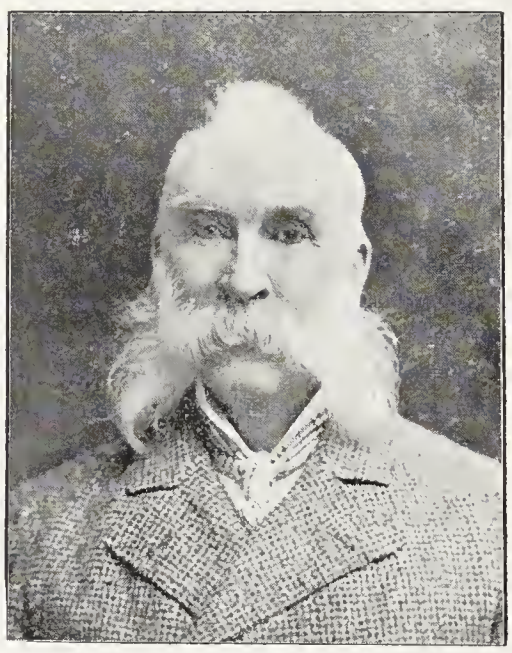
At the regular meeting, held January 20th, P. W. St. George, vice-president in the chair, the secretary announced applications for admission from Chas. Biggar, of Ottawa; H. F. Duck, Toronto; J. W. Fraser, Ottawa; Lewis Skaife, Montreal: for transfer from W. P. Morrison, Halifax; C. C. Wonsfold, New Westminster; students, G. A. Beauchand, E. Lorne-Bond, H. D. Pariseau, L. F. Gagon, H. L. St. George, F. T. St. George, all of Montreal.

A letter was read from Herbert Wallis, announcing the gift of a fire basket and fender for the accommodation of members in the new smoking-room, which, together with a reading-room, has recently been added. It was suggested that something should be done to celebrate the opening of these rooms. Prof. Nicholson suggested an exhibition of slides, illustrating great engineering works. Other members wished this to be followed by something free and easy for once, and in consequence a committee, composed of Profs. McLeod, Nicholson, and Durley, and Messrs. McCarthy and Loveless, was appointed to make the necessary arrangements for a smoking concert.

Prof. Nicholson then read the abstracts of two papers on "Some Experiments on the Condensation of Steam," and "An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing." The former by Profs. Callendar and Nicholson, and the latter by Prof. Callendar alone. Prof. Durley said that these papers were likely to impress any hearer of them with the great care and skill displayed by the experimenters, but he thought that the results would hardly appeal at first sight to the practical man. He would ask under what circumstances is the rate of condensation less than that given, and what would be the probable effect if the steam had been allowed to pass through as a current of considerable speeds. To which Prof. Nicholson replied that he could not say off-hand what was the velocity of the steam. The speed was considerably varied, and he could not say that

he found the rate of condensation attributable in any way to the rate of velocity.

J. Farmer, Ma.E., was then called upon for his paper on "Impulse Water Wheels." H. Irwin said he had not much to do with this class of work, but that it was fast coming to the fore, especially in mining districts. Prof. Durley had hinted that Prof. Nicholson had not shown the immediate practical advantage of his experiments. He (H. Irwin) greatly objected to the careless use of the word "practical." Very many men who claim to be considered practical are not practical at all. The theorist may be in advance of the customs of the day, but often the more practical for that very reason. Water wheels had been in use in older countries by "practical men," for a hundred years, and during all this time they had been losing half their power. The advance made in recent years was due largely to such comparatively isolated investigations. Prof. Durley quite agreed with H. Irwin, and meant not that Prof. Nicholson's investigations were without practical value, but it would have been interesting if Prof. Nicholson had shown their direct effect upon the practical use of water wheels. Mr. Farmer says that the higher the speed of the wheel the greater the arc of action. Has the high-speed wheel a greater arc than the low-speed one? Mr. Farmer replied that the arc of action was intended to refer to the time during which the water really acted on the bucket. Prof. Nicholson expressed his appreciation of the value of the paper. He had seen much written upon this subject, but the paper under discussion was the first to give accurate information. On the subject of the arc of action: did Mr. Farmer say whether a number of jets —say three or four—were ever used on the same wheel at different angles to get rid of the friction of the bearings? Mr. Farmer: "Yes. It is given in the Pelton catalogue." Prof. Nicholson: "Could not the defect of these wheels be got over by—say 15 jets?" Mr. Farmer: "It has its limits. He doubted whether more than five or six could be put in advantageously." Prof. Nicholson: "It would be interesting to make experiments with the throttling gate close to the jet." He again thanked Mr. Farmer. Prof. Durley proposed a vote of thanks to the writer of the paper. Mr. Farmer expressed his thanks, and wished that the experiments had been more complete, and the results more definite.



W. G. MacNeil Thompson, Pres. C.S.C.E.

W. G. MacNeil Thompson, who has just been elected president of the Canadian Society of Civil Engineers, is one of the best-known of Canadian engineers. He was from 1852 to 1856 engaged on surveys and construction of Grand Trunk Railway, Canada, from Toronto westward; from 1856 to 1859 he was resident engineer surveys and construction of Welland Railway. From 1859 to 1860, contractors' engineer and agent on River du Loup section Grand Trunk Railway, Canada; from 1860 to 1863, contractors' engineer and agent on reconstruction of Northern Railway of Canada; from 1863 to 1864, engineer and manager for Dyphusys Cassen Mining Co. of North Wales; from 1864 to 1868, engineer and agent for contractor of Ceylon Government railway from Colombo to Kandy; from 1868 to 1872, engineer on surveys and construction of Intercolonial Railway, Canada; from 1872, engineer in charge of survey of Lake St. Louie; from 1872 to 1889, resident engineer southern division Welland Canal enlargement to 14 feet; from 1889 to 1891, resident engineer Sault Ste. Marie Canal, Ontario; from 1891 to 1894, superintending engineer Sault Ste. Marie and Welland canals. At present Mr. Thompson is superintending engineer Welland canals. Mr. Thompson was elected M. Inst. C.E., 1877; M. Am. Soc. C.E., 1879; M. Can. Soc. C.E., 1891; Associate Am. Inst. E.E., 1887.

J. L. N. Coste, C.E.

Jean Louis Napoleon Coste, Chief Engineer of the Department of Public Works, who was elected member of council of the Society of Civil Engineers for the year 1898 at the annual meeting, held on the 12th of January, was born in Amherstburg, Ontario, on the 31st July, 1867. He is the eldest son of N. A. Coste, one of the collaborators of M. de Lesseps, in the construction of the Suez Canal, and of Mathilde Robidoux, a descendant of one of the men who came from Brittany with Jacques Cartier. Mr. Coste received his technical education in France, and was afterwards articled to the late Sir James Brunlees, past president of the Institution of Civil Engineers of England, with whom he remained several years on various maritime works, returning to Canada in 1883, when he was immediately employed on the staff of Mr. Smellie, then Chief Engineer of the Canadian Pacific Railway in Montreal. In November of that year Mr. Coste was appointed on the staff of the chief engineer of Public Works, and was placed in charge of works in Ontario, Quebec, and Manitoba. In July, 1892, Mr. Coste was appointed to his present position, that of Chief Engineer of Public Works, and as such has charge of the following works: (1) Construction of, and repairs to, wharves, piers and breakwaters built by the Federal Government in the Dominion of Canada. (2) The construction and repairs of all river works. (3) The dredging in harbors and navigable rivers. (4) The construction and administration of graving docks. (5) The construction, maintenance and administration of the slides and booms on the Ottawa, St. Maurice and Trent Rivers. (6) The construction and maintenance of inter-provincial bridges, and of all federal bridges in the North-West Territories. (7) The direction of all hydrographic surveys made by the department. (8) The preparation of all reports on the proposed construction by private enterprise of all works in or over navigable rivers.

## WATER POWER IN CANADA.*

Having been honored by re-election to the presidency, after an interval of ten years, I desire to thank you most heartily for this renewal of your confidence, and at the same time to congratulate the society upon its record in this the first ten years of its existence, during which total membership and revenue have increased about fifty per cent. Unlike our predecessors in England and America, we, as the offspring of later times, have encountered no early period of suspended animation, but have advanced steadily, if not rapidly, in numerical strength, and maintained satisfactory financial stability. If we have not progressed proportionately in public usefulness or mutual enlightenment, it may be ascribed (in some measure at least) to the fact that some from whom much could be expected are too closely occupied with daily duties to contribute, as they might otherwise do, to our "transactions." Some may be too modest, and some too old, or possibly too indolent.

If, however, we have held our own as we have done in these recent years (which embrace several of world-wide depression), our prospects for the future seem brighter than when we began our organization in 1887. Then our great railway systems were practically completed; and, although this was the case with our enlarged canal systems only as regards the Welland, the work on the St. Lawrence was in an inert condition. Ample leisure was then afforded Canadian engineers for organization, amusement or foreign travel.

Now, however, there is a decided change in our position at home and abroad. Canada is now a colony of national importance, the largest independent member of a world-wide Empire, and none have contributed more to this advanced position than engineers of every class embraced in our society, which, while it excludes none, is composed almost entirely of the constructive rather than the destructive order.

In 1887 Canada was not a mining country; now, recent discoveries over a wide extent of our vast Dominion have brought the mining engineer to the front, and with him the hydraulic and electrical engineer, because water power is almost

* Being the president's address at the Annual Meeting of the Canadian Society of Civil Engineers, Jan. 12th, 1893.

universal in our mining regions from Labrador to Alaska. Our vast prairies, where is grown the most valuable quality of the most important cereal, have hitherto been unable to attract much foreign interest, though accessible to all nations; but the recent discovery of gold has been of such a character as to invite world-wide attention. Its influence (however temporary) cannot fail to produce increased agricultural development in our great North-west.

Since the birth of our society water power has attained a position of immense importance, owing to electrical transmission, which has given rise to new industries only possible where there is cheap and abundant water power, which also secures cheap intense electricity.

The rapid extension of the pulp industry in Canada is one of the results of cheap water power coupled with our abundant supply of raw material, easy reach of navigation, of rail, and the best markets; but the more recent electro-chemical industries are the exclusive products of cheap intense electricity. Here (as in mining) is a new field for the chemical, electrical, hydraulic and railway engineer. I include the chemist among the engineers, because I regard him as such, with the electrician, the hydraulic or mining engineer, producers though not creators of power, and, it may be, the chemical force is more potent than any other. If dynamite is a chemical compound the power-maker or discoverer is worthy to be numbered with the power user.

An electro-chemical industry of recent origin has been established in Canada by the discoverer, a Canadian chemical engineer, Thos. L. Willson. This is the manufacture of calcic carbide for the production of acetylene gas by means of electricity produced by the abundant water power of the Welland canal at Merritton, where the manufacture in commercial quantity was first started in 1896, and from whence the product has already been shipped to England, France, Germany, Italy, Australia and South Africa.

Another electro-chemical manufacture in which our profession is interested (on water power ground), which also depends on cheap electricity, is that of aluminum, for which the raw material is so widely distributed, but for which, as with the carbide, abundant and cheap water power is indispensable.

In view of its importance, owing to its wide distribution over Canadian territory, from the Atlantic seaboard to the Rocky Mountains, where no coal is found, and on account of its vastly enhanced value since the discovery of high voltage transmission, even where it is within the coal fields, I have chosen water power as the subject of some observations for the annual address.

I have heretofore drawn attention to this widely-distributed power outside of our coal regions, as to some extent a substitute for coal, upon the assumption of local application of power in both cases, whether water or steam, and then the vast difference presented itself that with the last the power could be taken to the work, while with the other the work must be taken to the power; for there was no thought then of electrical transmission. The utilization of water power would be very slight and very slow if under the old conditions of advance into the forest (as in the agricultural portions of the valley of the St. Lawrence), because our greatest extent of water power is in the mountainous and sometimes barren regions, not inviting to agriculture, though most favorable for the accumulation, maintenance and uniform distribution of water power throughout the year.

In considering the question of water power generally, and in comparison with steam, it may first be mentioned that while electrical transmission (where practicable) has enabled it to take the place of steam in many situations, the choice in others depends upon the work to be done, as well as upon the cost of fuel. For transmission purposes there are only the questions of the sufficiency and permanence of the power and its superior economy; but for lumber manufacture, although ample water power is at hand, and there is with it no question of ice difficulties, it is found in many cases that steam is preferable, because the mill site may be chosen in the best position for manufacture, shipment and storage of logs, and the waste material furnishes fuel for power. The cost and maintenance of a mill dam in many situations, with the necessary piers and booms for the logs, the damage and risk to mills, etc., during floods, are reasons urged (in addition to the questions of site and fuel) in favor of steam for this industry. But for other purposes the site of the water power (perhaps in a gorge) is unfavorable for many industries on account of difficulty of access and want of service ground; and here is the value of electric transmission of water power.

When adopting water power, one of the most important considerations is the possible need of future enlargement. Where all the water power of a stream of any point is secured by a dam, and this power can be drawn upon from time to time until the whole is applied, we have only to consider cost, and maintenance in the first place, even though the additional power must thereafter be obtained by coal, or transmission (when this last is commercially practicable), not only because the water power is sufficient for many years, but as far as it goes, it is more economical than any other. But if only part of the available water power is needed, and provision for the future must be postponed for financial reasons, then the question of how any future addition can be made without interruption becomes important in proportion to the purpose for which the power is required. If for water supply or electric light, either the original dimensions must be far beyond present wants, or there must be the power of duplication without interference with existing conditions, or else temporary power for this purpose on a sufficient scale, or permanent, if made auxiliary for future deficiency of water. Such considerations affect the question of the economy of water power for certain purposes and under certain conditions where a periodical increase of power must be provided for. It altogether depends upon local conditions whether an artificial water power, as it may be called, will be worth what it costs for any purpose; and more particularly if this is one in which power must be reserved for future needs. Temporary employment of surplus power could not be counted upon to build up permanent industries.

Electrical demand and transmission have created a "boom" in water power, under which in some cases the schemes proposed may become financial failures. There is evidently a limit to the distance to which water can be artificially conducted in order to reach a fall under the most favorable conditions of route. For power purposes the only useful portion of the aqueduct is that which lies below the surface level of water in it, and the value of this is in direct proportion to its size, and therefore, its cost, which includes the cost of all required work above this level. The longer the aqueduct the higher must be the fall which it secures, and the lower the fall the larger must be its dimensions and cost if it is to be efficient. Whether it will be profitable in either case depends upon the cost. Such natural dams of rock as those of Niagara, Sault Ste. Marie, Rat Portage, the Chaudiere, the Chats and others on the Ottawa are natural water powers of the first order; but the artificial powers created by our canals (apart from cost of every canal adjunct to the water channel) would never have been undertaken for water power purposes. There is a popular superstition that there is more in water than its weight, because that weight is felt "all over" as well as on the bottom, and a tendency to ascribe to it a fictitious value. This has possibly something to do with some projects.

In water power the discovery of lowest possible head level is of the first importance, and the one often of the greatest difficulty where this is not controlled by a dam, which (wherever practicable) is the only certain means of fixing it. When a dam does not exist, or is not obtainable, recourse is had to legend and the "oldest inhabitant," who has seldom proved old enough for the occasion. Our canal engineers have, with the best information, found their mitre sills in many cases very much higher than they intended them to be, because the river had gone very much lower than it had ever been said to have done. To secure at all times a required depth it seems necessary to add about three feet to the "oldest inhabitant." When, over fifty years ago, the Government first constructed timber slides on tributaries of the Ottawa, in the absence of any knowledge of the local range of water level, the mouths of these were found so high after the first flood that the timber could not be floated into them until a dam was built for this purpose.

The high-water level is more easily provided against, and is often more important in connection with the tail-race in fixing the wheel level, where the discharge is into a reach subject to great variation, like that below the Chaudiere Falls, where the extreme range between high and low water exceeds twenty-five feet; which, though of short duration, is about three times as great as the same range above these falls. Where the wheels

would be affected, as this is always the case at the season when the rise is greatest at the head, provision may be made to utilize this temporary increase of head level so as to maintain the necessary power during back water.

Where unceasing operation of power is required in our climate, duplication and separation of flumes (and it may be in some cases of tail-race) may, where practicable, warrant the additional cost in thus securing reserve power (as well as of machinery) when any particular channel has a surfeit of ice; as well as by so much contributing to a future enlargement.

Except upon our canals (where the least winter difficulties are experienced), our great water powers have been chiefly used as summer ones, in which the two independent questions connected with water power, viz.: the power of enlargement and extension without interruption, and the possible ice difficulties of a northern site, do not come in question. The large sawmills have not worked in winter because their logs are frozen in. Before the railway reached them the mills stopped sawing when they could no longer ship their output; but, where they depend upon the water for their logs, whether they are worked by water or steam, they are idle in winter.

The coming of electricity, bringing with it the demand for winter power, has produced ice difficulties where they did not before exist, and were therefore not anticipated and not provided for, although winter water power, to a limited extent, had been in use. Increased power brought increased current, and this under certain conditions brought the submerged ice.

There is no question of more importance to our water powers than this one of uninterrupted operation in our northern districts where nearly all are located, and where (with perhaps the exception of the southern portion of our Pacific coast) ice in one form or another must be dealt with. It assails the moving water sometimes both from above and below, and, if undiscovered, chokes off the motive power.

In artificial channels the fixed surface ice above may diminish the water power by its increasing thickness and depression from superincumbent weight of snow saturated by winter rains and thaws, and, where these channels are fed from open water in which floating slush ice is moving, the latter may be drawn in to increase the throttling of the reduced water-way. The situation is greatly complicated by winter fluctuations of the open water from which the mill-race is fed, and in which the "slush" or "anchor ice" is running, a not uncommon situation in northern rivers which cannot be conveniently dammed or where sufficently large receiving basins cannot be created so that "slush" or "anchor ice" will not enter and travel through the mill pond to reach the flumes.

The ice question can be more fully appreciated by what has taken place in connection with water powers at Montreal and Ottawa. In the first case, the aqueduct of the Montreal water works, five miles in length, almost entirely in excavation, is fed from the St. Lawrence above the Lachine Rapids, where there is a smooth, swift current which prevents the freezing over in winter, but is often covered with "slush" or "anchor ice" when that is running. The Lachine Rapids below the intake of this aqueduct are of that ragged character that temporary ice dams often form and break away during the winter. These dams produce a sudden rise which extends to the aqueduct two miles above.

From the setting in of winter until March the river level steadily lowers, except when temporarily elevated by the ice dam, so that in the early spring there is the least depth of water at the intake, and the greatest depth of surface ice and saturated snow over the aqueduct, and the only water-way left is at the bottom where the width is least. The ordinary action of snowfalls, winter rains and thaws (the accumulations of three or four months) would of themselves seriously encroach upon the water-way in the widest part of its earth section, but these are (in this case) enormously increased by the sudden rise of the river while the ice is frozen to the aqueduct banks. This ice is overflowed before it can be lifted, and as these winter floods always occur during the severest weather, the overflowing water is immediately frozen, forcing the ice covering of the aqueduct further down until the half of more of the area of its water-way may be closed off.

These winter inundations seldom last long enough to send the river water far down the aqueduct, but their action at its mouth is all that is necessary to affect its power. The first one experienced was during the first winter the works were in operation. Nothing like it has taken place in the forty years which have since elapsed, and it was the only one which extended throughout the five miles of the aqueduct. In January, 1857, after nearly five days of below zero weather, in the middle of the night the water suddenly poured over the flumes in the wheel-house, sending an icy stream over the frozen surface of the ground for miles beyond. This ice-dam on the rapids caused a rise of four feet in a few hours at the aqueduct entrance. Years later this flood might have destroyed the usefulness of the aqueduct for the remainder of the winter, but the power then required was so small that winter difficulties did not arise until a later date, when the conditions were aggravated from another direction—below instead of above, and from another description of ice insidiously creeping into the winter-diminished water-way, due to the causes above described, and producing gradual suffocation. This did not take place until the combination of extreme low water in the river, extreme accumulation of surface ice and snow and increased draught to the wheels so quickened the current at the intake that it attracted the floating frasil or "anchor ice," which immediately that it touched the solid bordage ice at the aqueduct entrance was sucked under and soon arrested where the strangling process was slowly but surely closing the gap.

The lesson of this history is that in such situations, where anchor ice is wont to pass an intake basin is indispensable where possible, so large, wide and deep that the necessary supply for the power channel coming into it from the river will never create a current sufficient to attract the frasil. Anchor ice is only begotten in open water, and this in our climate always means water too swift to become self-freezing; and it will not leave this until enticed from the old paths by stronger currents. It is, therefore, only a question of cost to form a mill pond which it will not invade. Where this is limited, the boom which separates the river from the basin (forming a bordage to the ice cover of the latter) should be made deep enough to prevent the ice which is passing and crowding outside from being forced under it.

An enlargement of the aqueduct was undertaken twenty-five years ago, but it was not carried farther than seven-eighths of a mile from the entrance. It has prevented the incoming of anchor ice and enabled the aqueduct in high water winters to pump its full summer average. But, as the strength of a chain is that of its weakest link, so, for this purpose, the minimum power must be equal to the maximum wants, and auxiliary power will be required until the completion of the enlargement. Enlargement is not likely to be completed until the consumption is so increased that it will become cheaper to pump the whole by water power.

In high water mild winters when there is the minimum of ice obstruction, and an increased depth at its widest section, the aqueduct pumps its full summer average. Thus in March, 1890, it pumped 350 million gallons, while in March, 1893, it only pumped 46 millions, because when the river falls to a certain level all wheels are stopped to prevent further lowering of the ice in the aqueduct. This result would go to prove that, to meet our winter conditions in some situations, an increase of at least fifty per cent. on the necessary summer dimensions would be needed.

Until water power was required for pumping the city water supply, in 1874, there had been no important winter use of the power of the Chaudiere Falls. The large saw mills did not work after November. The few establishments on either side of the river where winter water power was used had no effect on the ice question, nor did the larger demands for the city pumping change the conditions in this respect. The advent of electricity, however, in which three large users of power engaged, revealed the fact that winter difficulties existed where they had not been anticipated. Fortunately, they have not yet seriously affected the city aqueduct, where, in the absence of auxiliary power or reservoir, they might produce a calamity.

The conditions at Ottawa differ from those at Montreal inasmuch as the aqueduct is fed from Nepean Bay, which is ice-covered in winter, and all the other mill-races upon the Ontario side draw under similar conditions. About a mile above these the foot of the Little Chaudiere Rapids is reached, and this is united with another rapid higher up, so that there is over a mile of open river in which anchor ice is manufactured and sent below in successive and frequent crops in severe winters. On the north, or Quebec side of the river, runs the only deep channel between the Little and Great Chaudiere. This is generally open water throughout the winter, and in it much of the anchor ice is carried into "the Kettle" and away from the mill ponds on either side. From this a subsidiary channel of considerably less depth crosses diagonally to Nepean Bay, discharging

into a depression in which there is a depth much greater than that of the channels leading into and out of it, and therefore a slower current. This is the point from which the supply to the city aqueduct is taken, and, in leaving it, the aqueduct begins between piers sixty feet apart placed in twenty feet of water, whereas the section through the rock after it leaves the river bank is only twenty feet wide with about thirteen feet depth of water. The excavation being entirely in rock, this aqueduct has the great advantage, for winter work, of having as great a width at the bottom as at the surface.

It was not known that any frasil passed through this bay under its ice covering, but it was believed that, if, and when it did, the slower current into the aqueduct would not attract it, and that it would pass outside in the main channel leading to the mills below. This has proved to be the case in the twenty-three years of the aqueduct's history, although there has been some frasil in the later years, causing a stoppage of the wheels on one occasion, for a few hours, by which stoppage its presence was first made known.

Unless anchor ice is expected and watched for, the first indication of its presence may be a sudden collapse of the water power. When the Montreal Aqueduct was first corked up at its mouth by anchor ice the wheels ran on until the five miles of canal was emptied, and the ice tumbled in, ruining it, as an aqueduct, for the time being. The same experience overtook the electrical power at Ottawa, and from the same causes, but under different conditions, emphasizing the necessity of local knowledge of bed as well as of the surface of the channels near and above the site of the power.

The whole Ontario side of the river bed is a submerged rocky plateau ten to thirty feet or more above the bottom of the north channel, so that if the river surface here at low water were lowered ten feet it would lay dry the greater portion of the southern half of the river bed, while there would still be deep water in all the north channel above the rim of "the kettle." As at Montreal, in a moderate and high water winter ice difficulties are not experienced, but, in very severe and low water winters, the thickened ice settles down on top of the shoals, reduces the depth and increases the current in the channels between them until one after another is invaded by frasil, coaxed in by the increasing draft towards the water power, and gradually shut off.

In these winters the output of anchor ice is a maximum, while the storage room beneath the field ice is reduced to the minimum. Moreover, as channel after channel is closed, the velocity in the remaining ones is so increased that the anchor ice is carried under miles (it may be) of an ice-covered surface, until it reaches the mill-races.

That anchor ice is carried long distances under the surface of an ice-covered river (or shallow lake with sufficient current) is proved by watching air holes near Montreal, where this ice is seen hurrying past, having come over the Lachine Rapids, below which none is formed after the river becomes ice covered.

On the other hand, in mild and high water winters there is the minimum of ice of all kinds, and the maximum depth of channel, and therefore the slower currents in them, so that anchor ice is arrested by friction under the field ice and frozen thereto, leaving some water-way underneath it.

The best way to fight anchor ice (which is the sole cause of the winter floods in the St. Lawrence) is to abolish it wherever this is practicable. It cannot be got rid of in the St. Lawrence, but could be at Ottawa by a dam at the Little Chaudiere. This could also be done in the Back River behind Montreal by a succession of dams, creating slack water (and water power) if this can be accomplished at a profitable outlay. On most of our tributary rivers this hoary enemy of water power can often be got rid of and a valuable water power created at the same time by means of one or more dams.

## THE STEAM ENGINE GOVERNOR AND ITS REGULATION.*

The matter of governing steam engines for a uniform speed under the greatest variation of load and steam pressure, and the economy in the use of steam, is no doubt one of the principal features in steam engineering, and I believe the same is absorbing more thought and receiving more attention from the engineer and engine-builder than any other subject connected with the steam engine to-day. I will now endeavor to point out the fundamental principle upon which the governor acts, and why it acts. There are two principles on which governors are constructed, one known as the centrifugal, and the other inertia action. The ordinary centrifugal fly-ball governor consists principally of a pair of cast iron balls or weights, suspended on an arm and at an angle of about thirty degrees from its vertical axis, and made to revolve round its axis as free as possible, generally driven by a pair of mitre gears. This principle of fly-ball or centrifugal governor was embodied in the first governor invented by James Watt, which has been more resorted to than any other, but aside from this the governor has been so improved and altered, and reconstructed since his time as to be almost unrecognizable, but still the old principle is there, and nearly, if not all, the prominent defects which so materially interfere with its efficiency.

The three principal defects are: First, friction; second, unbalanced force, caused by the different position of the levers and arms; third, unequal resistance, offered to counteract the centrifugal force. Now we will take friction, the first. It may be said it has been fairly well overcome for the most practical purposes, so far as the builders are concerned, but much depends on the engineer, as it is his place to see that no excess friction is allowed through improper lubrication of the working parts and poorly packed valve stems, etc. Second, unbalanced force: This defect appears to be much more difficult to overcome, and is certainly a greater detriment to the action of the governor. Like other parts of the steam engine, some governors are designed much worse than others in this respect, but the best of them are a long way from being perfect, and the reason may be explained in this way: Suppose we take, for example, the ordinary centrifugal fly-ball governor, and assuming the balls are traveling around in their normal plane, and say the arms are now at an angle of 45 degrees and traveling through the path of a 12 circle. The engine is now running 100 revolutions per minute, and the mean effective pressure is 40 pounds. Now, so long as those conditions are left that way, and there is no change in the load, the speed of the engine will be most perfect, but we cannot maintain this, so we will suppose the first change to be that the steam pressure shown by the gauge is allowed to increase. Now then, the mean effective pressure shown by the gauge becomes greater, and the engine then begins to move faster, and the governor in turn. Now there has been a change. The balls have moved to a higher and wider plane. This change simply means that the line of force has become closer to right angles with the vertical axis of the governor, therefore traveling through a greater radius, and the line through the point of gravitation has become further away from the fulcrum, therefore the speed has to be increased to overcome the increased weight of gravity, caused by the change of angularity, and so the engine continues to increase in speed until enough momentum has been stored to balance the balls in their new position. So then it is quite consistent that the force that will support the balls in one plane will not support them in a higher one. Therefore, the speed of the engine must vary when controlled by such a governor. Third, unequal resistance offered to counteract the centrifugal force. This is sometimes applied by a lever and ball, and sometimes by a spring. Where the ball is used we still have the same trouble as in the fault of the second, namely, angularity; and where the spring is used it is much worse than the ball, because the tension of the spring increases as the spring is drawn out. For example: If we have a spring attached, and offered 20 lbs. resistance, when it was drawn out, say one inch. Supposing now that part of the load was thrown off, the balls would then have to be speeded up to a higher plane, say enough to cause the springs being drawn out another inch; then the spring would be holding 40 lbs., and of course the balls would have to be speeded fast enough to support this extra 20 lbs.; possibly this might mean two or three revolutions faster for the engine.

The object of applying resistance to the governor may be said to have two purposes. First, to assist the gravitation of the balls when coming to a lower plane. Second, to permit the changing of the speed of the engine by adjusting the ball or spring until the required speed is maintained. This resistance, however, has been made automatically adjustable by several inventors in the last few years. This has bettered matters considerably, but still the speed of the engine must

*A paper read before the Hamilton branch of the Canadian Association Stationary Engineers, by H. G. Mitchell, President Ontario Association Stationary Engineers.

change before the attachments are caused to act. So as it is, the engine has first felt the change of load, causing it to slow up in speed, then the governor feels the change, which in turn causes the attachment to act; therefore it is just a little too late in acting, as the speed has already slowed up, but if the governor had felt the change before the engine, then things would have been different; and so it is with the centrifugal governor that the momentum has to be increased to act one way, and decreased to act the other way. Now, I will leave the centrifugal governor and take up the other principle of governor, called inertia. As it would make this paper very lengthy to go fully into this, I will only endeavor to touch on a few principal points.

First, we will suppose the inertia to be connected on a shaft governor. The principal part of this apparatus consists of one straight arm with a fixed weight on each end, and pivoted in the centre to a fixed point of the wheel near the centre of the shaft, thus allowing the balls to move in a rotating direction only, and always in the same plane, thereby doing away with the troublesome change of angles, as well as the use of the centrifugal action. There is a spring attached to the arm about the centre of its radius and the other end to the rim of the pulley which surrounds the governor. This spring is used to offer resistance to the acting energy of the rotating weights, and also to assist the momentum in opening the valve. Now, it will be seen that when this apparatus is put in motion the pulley and engine will gradually advance ahead of the suspended weights and continue on so until the valve is adjusted to the proper cut-off to balance the load, and when any extra load is felt by the engine the weights will continue to go on in advance of the engine, thereby increasing the travel of the valve, and permitting a later cut-off. So with this apparatus there is no reversing of motion before the governor responds.

## THE TORONTO CITY HALL.

There are some people of so critical a nature that they are invariably opposed to the course of action pursued by all those who are in authority over us. Like the Scotch elder, they can "aye object." These are useful, if objectionable people. They occasionally cause an arrest, which is a public service, and to be commended, even though the everlasting cries of "Stop Thief" disturb our after-dinner nap. The opposite class in the community believes that everything that is is right. He believes in the divine right of kings, aldermen and pickpockets. He always votes for the Government, whatever it may be and is a man such as Cæsar likes, who "sleeps o' nights."

Between the critic who is never satisfied and the man whose creed is, "All's well in the world," THE CANADIAN ENGINEER wishes to pursue a middle course. To praise where we believe praise is due, and to blame where we believe cause for blame can be found; and there is the rub. To the end that we may discover if any cause for blame anywhere exists, we intend to ask a few questions, the answers to some of which would determine the fact. In another issue we will take up the question of praising the praiseworthy features, and they are many, of the city hall.

When Elliott & Neelon accepted the contract for the masonry work on the city hall at $838,061, did they expect to make a profit? If they did, how is it that the architect has spent all but a small sum of this amount, and has not yet quite completed the work called for under this contract?

Are we correctly informed that the execution of the work on the lines laid down in the specification upon which this contract was let would have left a very large profit?

Assuming that this profit would have been made by Elliott & Neelon, why has it not been made by the city?

Has the fact that there would have been some question as to whether Mr. Lennox would have been paid his 4½ per cent. on the amount of the profit anything to do with the fact that it has disappeared?

The specifications call for a wall, which was practically a brick wall with a stone facing. As it stands to-day, the building is a stone building, whose walls are of stone with a brick lining.

Are we correctly informed, when we are told that there is 10,000 feet less radiating surface now in the building than the specifications for the heating plant called for? Such a change as this would, of course, only make a small difference in the total, amounting to between $3,000 and $4,000, and we understand that Mr. Lennox is empowered to make any changes that he may see fit.

Of course, such changes will be allowed for and may offset other changes which would otherwise figure as extras.

A short time ago when the architect was instructed to forthwith prepare plans for the dado of the entrance hall, he declined to do so on the ground that he had to accompany a contractor to the United States to select some appliances for the building. In the ten years in which the plans have been in course of alteration, it would appear possible to have prepared even alternative sets of such detailed drawings as these.

Does the architect journey to and fro, assisting all contractors to select their material, and if so, at whose expense?

## THE NIAGARA POWER COMPANY.

We have all along expressed the hope that the Ontario Government would take some decided action to undo the great wrong which they committed when they handed over the water-power at Niagara Falls to an alien company, and one whose best interests were served by the least possible development on the Canadian side of the river The session has been allowed to pass and nothing has been done. The only indication of any intention or desire on the part of the Government to make of the resources of Ontario anything greater than a pleasure ground for the United States tourists, or dividend earners for United States capitalists, is the following letter written by the Hon. A. S. Hardy, Premier of Ontario, to F. W. Hill, mayor of Niagara Falls, Ont., a short time ago:

Toronto, Jan. 19 1898.

DEAR SIR,—In reply to your question as to whether it is the intention of the Government to grant to the Canadian Niagara Power Company an extension of time for either the beginning or completion of their work on this side of the Niagara River, I beg to say that in April, 1897, in reply to an application, the company was informed that the agreement made no provision for an extension of the time for either the beginning or the completion of the work, and that it did not appear possible to the Lieutenant-Governor-in-Council to grant such an extension. This appeared to be accepted by the company as final and conclusive, and no further application has been made since then. I feel quite at liberty to say that there is no change in the policy of the Government on this point, and that should a further application be made for an extension it is the intention of the Government to adher to this policy and to the terms of the contract.

I am, etc.,
Very truly yours,
A. S. HARDY.

F. W. HILL, ESQ., Mayor Niagara Falls, Ont.

The question still remains an open one, for so far the Company has complied with the terms of its contract, work was begun within the stipulated time, and the only hope of the promise contained in this letter being carried out, that the company does not carry out the work within the date set within the contract. It is merely a question whether it wishes to hold the monopoly or not; with the resources in men and money which the company can command, it would be possible to deliver the required number of horse-power within the time specified, but the performance of the work in the time which is now left would be exceedingly expensive, and could not be done to the best advantage.

If the Niagara Falls monopoly wishes to retain the industry of southern Ontario in its death dealing grasp, it can do so. If it does not so wish, Premier Hardy will not compel it. That is what the letter may be said to mean.

## LITERARY NOTICES.

"British Columbia and the Canadian Yukon Year Book" for 1897, by R. E. Gosnell, Librarian and Secretary, Bureau of Statistics, Victoria, B.C., has just been issued. It is one of the most comprehensive works on British Columbia published in recent years. It contains over 500 pages, eighty of which are occupied by representative illustrations. There is a series of specially engraved maps, and eight lithographic diagrams illustrating British Columbian progress. A special chapter is devoted to Klondyke and the Canadian Yukon, with latest map issued, showing routes. The table of contents is arranged under headings, such as Historical Review, Parliamentary and Judicial, Municipal, Educational, Indians, Physical Characteristics, Forests, Fisheries, Agricultural, Mining, Sociological, Trade, Railways, Canadian Yukon, etc., etc. Price (postage free), in cloth, $2.50; in paper, $2.25. R. E. Gosnell, Librarian Legislative Assembly, Victoria, B.C.

We find in the Methodist Young People's paper *Onward* the following expressions about the Canadian press. Our readers will have no difficulty in recognizing the *Montreal Witness* as the paper specially referred to: "Nowhere, we think, is there a press of higher moral tone than that of our beloved country. It possesses, we think, the unique distinction of having a leading journal in its largest city which for over fifty years has been a moral crusader, a champion of reform. In all that time it has not published one liquor, or tobacco, or theatrical advertisement. At the sacrifice of much money it has stood true to its high principle, and stands foursquare, a tower of strength, against all the winds that blow."

## ASSOCIATION OF ONTARIO LAND SURVEYORS.

The following papers are expected to be read at the annual meeting of the Association of Ontario Land Surveyors: "Drainage," John H. Jones, O.L.S., Sarnia; "Irrigation Works on Dominion Lands," A. W. Ponton, O.L.S., Regina, Ass.; "Unrecorded Original Field Notes," J. J. Murphy, Crown Lands Department, Toronto; "Acetylene Gas and its Uses," V. M. Roberts, O.L.S., St. Catharines; "Evidence," M. J. Butler, O.L.S., LL.B., Napanee; "Lake Erie Survey, Otto J. Klotz, O.L.S., D.L.S., Ottawa; "Sudbury Water Works," S. V. Rorke, O.L.S., Sudbury; "Use of Field Tile for Large Drains," W. M. Davis, O.L.S., Woodstock; "The Economic Resources of the Hudson Bay District," J. W. Tyrrell, O.L.S., Hamilton; "Assessment Plans," P. S. Gibson, O.L.S., Willowdale; also papers by Jas. Hutcheson, O.L.S., Guelph; F. W. Farncomb, O.L.S., London, and several others. The date of annual meeting of the association is fixed for 22nd February, but arrangements are being made to meet on that date *pro forma* and adjourn to 8th March. The Board of Examiners will hold its annual meeting at the Department of Crown Lands, beginning 14th February.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

On Saturday evening, January 15th, in Temperance Hall, Bathurst street, Toronto, Toronto Branch, No. 2, C.A.S.E., was duly opened and the following officers installed by Executive President E. J. Philip, assisted by the officers of Toronto No. 1: Past President, P. Trowern; president, John Dixon; vice-president, John H. Venables; recording secretary, Thomas Graham, 570 King street west; financial secretary, J. Richardson; Treasurer, Joseph Hughes; finance committee, F. Tushingham, E. Thomas, T. L. Holmes; trustees, John Dixon, J. McMulken, P. Trowern; conductor, M. Connolly; doorkeeper, H. Brown. Immediately after the installation ceremonies were over President Dixon delivered his maiden speech, and, in conclusion, invited the visiting brethren from Toronto No. 1 to partake of refreshments, which were duly appreciated and ample justice done to the elaborate supper, which was served by the wives and daughters of the officers. After the usual toasts, speeches and songs, the gathering dispersed with the singing of "Auld Lang Syne."

The regular meeting of Toronto No. 1, C.A.S.E., was held January 19th. There was a large attendance, and one initiation. The committee appointed to get up the annual At-Home and reopening of the hall reported that all arrangements had been completed to hold the At-Home on Thursday evening, Feb. 3rd. A general good time is guaranteed. Tickets, 25 cents. There is to be a concert, refreshments, dancing, and other amusements. The trustees reported that they would have to draw on the association funds, the insurance allowance not being enough to finish furnishing and decorating the hall, but when complete the engineers will certainly have one of the finest suites of rooms in the city. Bro. Wickens will continue his paper on the "Indicator" at the regular open meeting on Tuesday, February 8th. All engineers and manufacturers are invited to be present.

—We have received the fifty-first volume of the Canadian Almanac from the publishers, Copp, Clark Co., Limited, Toronto. Besides being a directory of clergy, militia, Government officials, members of Parliament, county and municipal officers, schools and colleges, barristers and solicitors, and other public men, it is a compendium of information of all kinds relating to Canada. Some of the more prominent departments are: Short History of Canada, Tariff of Customs, Forms of Government throughout the World, Post Office Gazetteer, Masonic Lodges, Miscellaneous Societies, Historical Diary, Life Insurance. Some new features for 1898 are: Short Accounts of the British Army and the British Navy, with illustrations; also articles on the English Government, and Extradition and Pardons. Besides the above, with every copy of the Canadian Almanac for 1898 is presented a map of North America, beautifully engraved and printed in five colors. The price, 25 cents.

—W. B. McKenzie, chief engineer of the I.C.R, has an article in the New York *Engineering News* recently, on the "Tidal Marshes of the Bay of Fundy." Between the Bay of Fundy and the Strait of Northumberland lies a strip of low land 15 miles wide. During the post-tertiary submergence, this part of the country was 220 feet below its present level, and the Champlain and the Saxicava sands were being deposited on the sea bottom. Tides of the ordinary height, 10 to 15 feet perhaps, swept across into Northumberland Bay. Mr. McKenzie states floating ice was carried in both directions and has left its deep grooving on the bordering shore. Several shore terraces, now standing high above the sea, tell that the land rose spasmodically. When the "divide' appeared, the Isthmus of Chignecto was low, and the eastern part was no longer an island. The tidal wave was thrown back upon itself, and while recovering from the shock lost part of its load or sediment. Since then, the tides have been depositing this material and filling up the valleys and fresh water streams flowing into the Bay of Fundy, forming these great prairie-like salt marshes which now constitute much of the agricultural wealth of New Brunswick and Nova Scotia.

# Industrial Notes.

THE Stempel Fire Extinguisher Company has removed from Berlin, Ont., to Toronto.

THE Paris Electro Plating Company, Paris, Ont., has sent its friends an attractive calendar.

THE employees of the Westinghouse Air Brake Co., Hamilton, Ont., are working 13 hours per day.

THE Stouffville, Ont., waterworks were tested January 14th, and gave complete satisfaction it is reported.

EDISON FITCH, Etchemin, Que., will shortly build a new woodworking factory, stone, 134 x 43 feet, to cost $12,400.

THE Stratford Bridge Co. is building a highway bridge 110 feet long at Greenfield, Waterloo county, Ont.; cost, $1,084.

HARVEY & Co., merchants, St. John's, Newfoundland, have started up their pulp factory, at Black River, Placentia Bay.

THE Goldie-McCulloch Co., Limited, Galt, Ont., will enlarge its offices and extend the molding shop, owing to the enlarging business.

THE by-law granting a bonus of $62,000 to the Abbott Rolling Mills Co. was carried in Kingston by a very large majority, Jan. 13th.

THE Smith Axle Works Co. is consolidating its business in Guelph, Ont, some carriage hardware formerly made in London being now manufactured there.

THE thirteenth annual meeting of the Illinois Society of Engineers and Surveyors, was held in the Court House, Peoria, Illinois, January 26th, 27th and 28th, 1898.

THE officers of the Halifax Board of Trade for the year are: President, Geo. Mitchell, M.P.P.; vice-presidents, W. A. Black and J. E. DeWolf; treasurer, H. G. Bauld.

A LICENSE has been granted the Norton Manufacturing Company, of Illinois, U.S.A., to manufacture and sell sheet-metal goods and other articles in the Province of Ontario.

MCOUAT & MCRAE, machinists, Lachute, Que., have put on extra hands to fill an order for six pulp grinders and other machinery for Hamelin & Ayres' new pulp mill in that town.

A. WATSON, A. and Wm. McLachlan, A. H. Deike, Elizabeth J. Deike and J. Mitchell, Guelph, Ont., have applied for incorporation as "The Guelph Acetylene and Gas Generator Co., Limited."

THE officers elected for the year by the South Kootenay Board of Trade, at Nelson, B.C., are: President, John A. Turner; vice-president, H. J. Evans; secretary-treasurer, H. B. Thompson.

THE officers of the Chatham, N.B., Board of Trade for the year are: W. S. Loggie, president; W. B. Snowball, vice-president; J. D. B. F. Mackenzie, secretary; George Stothart, treasurer.

WE have received a neat little calendar from the McLaren Belting Co., of Montreal and Toronto, accompanied by a handy price list of belting, card clothing, studs, pulleys, and the various other articles dealt in.

THE city of Belleville, Ont., is inviting correspondence with manufacturers desiring to establish new industries or extend existing ones. Liberal terms are available for substantial firms desiring a location in Belleville.

JOHN BENN, proprietor and manager of the dynamite works at Tweed, Ont, has sold out to Daniel Smith, Montreal. The new firm will be known as the Ontario Powder Works. Mr. Benn will be retained as manager.

THAT the goods manufactured by the Goldie & McCulloch Co., Limited, Galt, are gaining a wide reputation, is evidenced by the fact that the company has recently received an order from a London, England, firm for blocks and tackle.

THE sheriff took possession of the Toronto Junction Foundry Co., Limited, a short time ago, which was incorporated last year with an authorized capital of $24,000. Of this sum $8,700 was paid, but this proved insufficient. The business will be wound up.

LETTERS patent have been issued to J. Goodison, J. F. Lister, C. Mackenzie, E. F. Goodison and W. T. Goodison, Sarnia, as the John Goodison Thresher Company of Sarnia, Limited, to manufacture and sell threshing machines and agricultural implements, with a capital stock of $90,000.

THE company which is negotiating with St. John, N.B, for starting a pulp factory at Mispec, near St. John, was registered at Edinburgh, in December. The directors are:—J. Galloway, W. Dixon, F. Wallace, P. Grosset and C. Anderson, all of Scotland. Registered office, Royal Bank Buildings, Leven, Fife.

BOWMANVILLE, Ont., will buy a fire engine.

WALLACEBURG, Ont., is to have a new $8,000 hotel.

THE Woodstock, Ont., town council will buy a fifteen-ton road roller.

LONDON, Ont., erected new buildings last year to the value of $270,000.

PORT COLBORNE, Ont., voted approval of the waterworks by-law last month.

THE new water system at Cowansville, Que., was satisfactorily tested recently.

THE Canada Switch and Spring Co., Montreal, has installed a Bessemer steel plant.

THE Hamilton, Ont., Waterworks Department shows a surplus for last year of $5,000.

SHELDON & SON, Aylmer, Ont., iron founders, are moving into larger premises, it is reported.

THE Berlin, Ont., Waterworks Company is going to put in a system in Waterloo, Ont., this season.

C. N. ROBERTS has been engaged to take charge of the waterworks pumping plant at Renfrew, Ont.

A GOOD roads convention was held at Sweetsburg, Que., last month, which was addressed by A. W. Campbell, the Ontario road instructor.

ELIAS ROGERS has been elected president of the Toronto Board of Trade by acclamation, and A. E. Kemp vice-president, also by acclamation.

THE Graham Nail Works, Toronto, has installed recently a 35 h.p. gas engine, which it is estimated will effect a large annual saving in running expenses.

EIGHT new elevators have been built on the line of the Calgary and Edmonton Railway in one hundred miles north of Red Deer during the past season.

HOUSE & FISK, Lansing, Mich., are corresponding with Galt Ont., about starting the manufacture of the Patterson acetylene gas generator in that town.

NEGOTIATIONS between the refiners of Petrolia and a group of English capitalists, looking towards the consolidation of the refining interests, are still going on.

W. J. KNOWLES, late vice-president of the Goold Bicycle Company, Brantford, Ont., is organizing a new company for the manufacture of bicycles in Canada.

THE Kerr Engine Works, Walkerton, Ont., recently supplied the waterworks commission, Kaslo, B.C. five fire hydrants, nine 6-inch gate valves, four 3-inch gate valves, thirteen valve boxes.

THE tender of the Dominion Bridge Company for the erection of a new iron bridge over the St. Francis, in place of the old Aylmer bridge, Sherbrooke, Que., was $8,386; weight, 284,000 lbs. Accepted.

THE Chatham, Ont., Dredging Company has been notified by the township of Tilbury North that it has been awarded a contract for dredging Trembly Creek, which will amount to $4,000.

As a result of favorable votes, last month, on by-laws to establish a House of Refuge in Bruce County, carried in Lucknow, Walkerton and Kincardine, such a building will no doubt be erected at an early date.

THERE was recently cast at the Londonderry, N.S., Iron Works, a pipe 42 inches in diameter, made of Nova Scotia iron, and weighing nearly three tons. It was ordered for a culvert on the P. E. Island Railway.

THE sources from which Rossland, B.C., proposes to secure a water supply are Stoney Creek, 470 gallons per minute, from an elevation of 375 feet, distance 4 miles; and Murphy Creek, 500 gallons per minute, from an elevation of 600 feet, distance 10 miles.

THE Maritime Sulphite Fibre Co. have completed a mill on the Canada dock, Chatham, N.B., for cutting, barking and preparing wood for the grinder in the pulp mill, and another similar mill is in course of construction. In operation each mill will employ about 25 hands.

IT has been decided to liquidate the Taylor Iron and Steel Co., Limited, Montreal. The company was chartered about a year and a half ago to take over the business formerly carried on in boiler tubes and general steamfitters' supplies, by J. & H. Taylor. The liabilities are under $10,000.

INCORPORATION has been granted to The Hamilton Acetylene Gas Machine Company, Limited, with a capital stock of $45,000, and these members: G. S. Bingham, Mrs. A. Seguin, F. A. Carpenter, W. R. Moore and S. D. Biggar, of Hamilton, and J. D. Forsyth, of Claremont, Ont.

AN English syndicate has been formed, it is said, to erect palatial hotels at Halifax, Montreal, Ottawa, Toronto and Niagara Falls. The plans also include a big hotel in London, England, that will cater to the colonial trade.

LETTERS patent have been issued to R. McDougall, Thomas McDougall, A. J. Oliver, R. McDougall, Jr., and Elsie McDougall, Galt, Ont., as the R. McDougall Company, Limited, to manufacture and sell hot-water, steam-heating and ventilating apparatus, and carry on business generally as iron founders.

THE Kingston and Montreal Forwarding Company has closed a contract for the construction of an elevator at Coteau Landing of a capacity of 500,000 bushels. The contractor is under heavy bonds to have the elevator ready to receive grain not later than May 10th next. There will also be a large warehouse in connection with the elevator.

C. H. TAYLOR, of the Taylor Hydraulic Air Compressor Co., Montreal, has returned from British Columbia, where he arranged for installation of a 500-h.p. plant, at Ainsworth, B.C. Contracts have been let and the work is rapidly progressing. The power is to be sold to mines within a radius of five miles of the compressor at a low rate.

THE gifts of W. C. McDonald to McGill University now amount to close on a million and a half dollars. The equipments of Mr. McDonald's three buildings are the most modern, as well as the finest, in America, and the endowments are such as contemplate their remaining always modern. These gifts make Montreal the envy of other cities.

C. H. ACTON BOND and Sanford Fleming Smith are the members of a new firm of architects in Toronto. Messrs. Bond and Smith have had several years' experience in New York, and are specially well qualified by their experience in that city to undertake the steel construction which is now so much employed in large buildings. The firm has at present four residences in Peterboro, Ont., and one in Ottawa under contract.

WE have received from P. S. Gibson & Sons, of Willowdale, Ont., the engineers of the Township of York, their report on the state of public works in the townships of Coleman, Todmorden, Deer Park, Bracondale, Swansea, Lambton Mills, Mount Dennis, North of Weston, Downsview, etc. It deals with needed extensions in sidewalks, the condition of those long in use, and lighting, and contains a pronouncement by the township solicitors on the responsibility for damage done by traction engines.

A. ROBILLARD, St. Andrews, Que., is the inventor of a new system of operating swing bridges for canals, railways, etc. It dispenses with the central shaft, or axle, as well as with the wheels. Instead of these, Mr. Robillard introduces a ball-bearing system. The surface friction is thus reduced to a minimum, requiring one man to operate it where it now requires several. Another feature of the invention is an automatic system of opening and closing the gates at the entrance to the bridge. As soon as the bridge commences to swing open, the gates close, and the movement which closes the bridge causes the gates to open.

THE fact that iron is being exported from the United States to Europe is said to be influencing the proprietors of the Nova Scotia Iron Works at Ferrona, in Pictou county, to discuss the removal of the works to Louisburg, Cape Breton. The original object in locating the works at Ferrona was to be alongside the deposit of ore supposed then to exist there, and also to be near coal and limestone. But the deposits of ore were not extensive, and now nearly all the ore used comes from the company's ore beds in Newfoundland. It is further said that Pictou county coal is not so well suited for smelting as is Cape Breton coal. In fact, the company made practical tests of the latter, with the result that they ordered something like 10,000 tons. This had to be taken from Louisburg to Pictou Landing by water, and then to Ferrona by rail. By locating at Louisburg the company would be alongside the kind of coal they require, and would be saved the haul by rail of their ore from Newfoundland. They would also have an advantage over Alabama competitors in the matter of freight, the latter being handicapped with a haul of several hundred miles to the seaboard and a longer ocean journey. At the meeting of the company held at Halifax a short time ago, the project was discussed, we are told, in all its bearings. The authorities of Sydney, having heard of the possibility of removal, made proposals that Sydney, not Louisburg, should be chosen, because it offers advantages in point of situation, railway and shipping facilities, etc., fully as great as Louisburg, while a proposal of exemption from taxation, or cash bonus, has been made by resolution of the town council, to any "coal mining companies or other companies which will locate their workshops, offices and shipping piers on the peninsula of Sydney." If it should prove to be the intention of the company to locate their works in Cape Breton, with the object of making pig iron for export abroad, it would seem to be well placed and circumstanced for such an enterprise, either at Sydney or at Louisburg.

JOHN JOHNSTON, a lumberman of Orillia, is building a planing mill at Ahmic Harbor, Ont.

THE Mac Machine Company has decided to remove its plant from Trail to Rossland, B.C.

THE shareholders of the nail factory, St. John's, Nfld., received a dividend of 6 per cent. on last year's business.

THE G.T.R. foundry, employing about 75 to 100 men, in Hamilton, Ont., has been closed down; part of the plant will be removed to Montreal.

S. CARSLEY, dry goods merchant, Montreal, is going to rebuild the old Canada Life building, St. James street, Montreal, in white marble as a store.

THE officers of the Berlin, Ont., Board of Trade for the year are: President, C. K. Hagedorn; vice-president, G. V. Oberholtzer; secretary, J. S. Hoffman.

AT the annual meeting of the Brantford, Ont., Board of Trade, Henry Cockshutt was elected president; T. H. Preston, vice-president; George Hately, secretary-treasurer.

A WRIT has been issued against the Welland, Ont., council of 1897, by the Waterous Engine Works Co., claiming damages for the non-fulfilment of the contract to purchase a fire engine.

G. BROWN, Westmeath township, Renfrew county, Ont., has been awarded the contract for building the bridge across the Colounge River, near Colounge, Que. The contract price is said to be $6,000.

THE building of the Simcoe County House of Refuge was awarded to A. Tessier, of Penetanguishene, for $14,966, exclusive of plumbing and heating. J. R. Eaton's tender was $18,914, without the plumbing.

CORNWALL, ONT., and Hull, Que., are in correspondence with the Toronto Rubber Company, which proposes to remove its Port Dalhousie factory to some locality where a water-power of three or four hundred horse-power can be obtained. The company pays out about $100,000 per annum in wages.

C. W. YOUNG, who has been president of the N.B. Granite Works at St. Stephen, N.B., for the past several years, has bought the business, and will run it under the same name. He has also bought the shot tower, which is situated near the mill, in which the shot necessary for the work of polishing the stone is manufactured.

THE engineering trades strike in England was ended at a meeting of the committees representing the federated employers and the allied trades unions on January 29th, when the result of the ballot accepting the employers' terms was communicated, and a formal agreement embodying the terms of the settlement was duly signed and arrangements were completed for a simultaneous resumption of work in all the federated workshops.

No. 13 St. Sacrament street, Montreal, in which the Montreal Stock Exchange is located, is to be rebuilt. David Ogilvie is the architect in charge, and the Dominion Bridge Company has already been awarded a contract to put a steel frame in the building, which will receive an additional story or two. The new walls and floors will be of marble and tiling. The woodwork is to be of white ash, and the elevators will be electrical. There will also be an ornamental iron stairway.

SIX important amendments to United States patent laws came into force on January 1st, 1898, which in substance are as follows: 1st. A patent will not be granted to an applicant if the invention has been patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to his application. 2nd. A United States patent will not be granted to an inventor who has obtained a foreign patent, unless his United States application be made within seven months of the date of filing of the foreign application. This clause, it will be noted, only applies when the foreign patent has actually issued, and is not merely applied for. 3rd. The application must be completed and prepared for examination within one year after the filing of the petition, and must be prosecuted within one year of the date of any official action thereon. 4th. The prior issue of a foreign patent will not now limit the United States patent to expire at the end of the legal term of the foreign patent. 5th. If an assignment, grant or conveyance be duly acknowledged before a proper officer, the certificate of such acknowledgment under the hand and seal of such officer will be *prima facie* evidence of the execution of such instrument. 6th. No damages can be collected for infringements of a patent occurring more than six years previous to the filing of a bill of complaint or the issuing of a writ. The second amendment referred to is of immediate importance to Canadian inventors, and it is desirable that they thoroughly understand it, so that on one hand they may make their United States applications in due time, and on the other be prepared to meet the attempts of unscrupulous United States firms to entice them into making worthless United States applications.

THE Page Wire Fence Co. has received an order from the Atlantic and Lake Superior Railway Co. for two hundred miles of standard railway fencing. This amount of fencing will make about thirty car loads.

# Electric Flashes.

M. B. QUINN, Windsor Mills, Que., has built a flour mill which is operated by electricity.

IT is stated that the Royal Electric Co., Montreal, will shortly absorb the Montreal Gas Co.

THE Canadian General Electric Co. has sent out to its friends a very handsome wall calendar showing a view of the works at Peterboro, Ont., and gold background.

COMMUNICATION by the new cable between Turk's Island and Halifax, by way of Bermuda, was established Jan. 17th, and business despatches are now being transmitted.

THOS. EDISON, JR., has planned an apparatus for generating electricity from the wave motion of the ocean by means of floats which would operate an air compressor.

THE corporation of Magog, Que., has placed an order with the Canadian General Electric Company for a 2,000-light alternator of their single phase, revolving armature compounded type.

THE Northey Manufacturing Company, of Toronto, has increased the capacity of its incandescent lighting plant recently purchased from the Canadian General Electric Company from 250 to 350 incandescent lamps.

THERE is a move on foot to get an electric railway service for the Island of Orleans, near Quebec. It is reported that a charter will be asked for at the next session to construct an electric railway around the island. The power is to be obtained from the Montmorency Falls.

MUCH surprise has been expressed in the trade because Hon. J. I. Tarte let the contract for four Westinghouse 40 horse-power electric motors, and four Worthington pumps, one of each of which are to be placed in the East, West, Centre and Langevin blocks of the Parliament Buildings, at Ottawa, to Ahearn & Soper, Ottawa, for $30,000, without calling for tenders.

THE street cars in Toronto have been equipped with a new appliance which does away almost entirely with the use of the immense snow sweepers. The digger is a contrivance that attaches to the machinery of the car, and by pressure from the motorman, digs down into the groove of the rail and cleans out the snow. It is the invention of Foreman Power of the Toronto Railway Company's car building shops.

IT is understood that Engineers Keating, Toronto; Pearson, New York, and Wanklyn, of the Montreal Street Railway, have visited the new Chambly works with a view to report upon the feasibility of using that power for the Montreal Street Railway, which, in producing its own power, reaches a rate very nearly $42, or $360,000 per annum, while the Chambly people have, it is said, offered to furnish the company with power at the reduced figure of $32, which would mean a great deal to the shareholders.

WORK was begun on the power house of the Hamilton Cataract Power Company, near Decew Falls, Jan. 8th, and it is being pushed towards completion. The building is to stand within a few feet of the edge of the stream, and above high water level, where the precipitous banks rise nearly 275 feet above the level of the stream. When completed, the power house will be 174 feet in length and 42 feet in width, and the walls 30 feet in height. It is to be constructed throughout of steel, faced with brick, and have concrete floors. The stone is quarried on the spot, and the cement is supplied by Battle Estate, Thorold. Angus McDonald & Co, Hamilton, are contractors for the construction of the canal, power house, etc.

THE Guelph Light and Power Company has decided to replace the arc lighting machinery for supplying the street circuits with the latest and most approved machinery for the purpose, and has placed an order with the Canadian General Electric Company for an 80-light Brush arc machine, equipped with automatic regulator. These large Brush machines, of which eight having a capacity of 125 lights each, have been purchased by the Toronto Electric Light Company—four of the same size by the Montmorency Company of Quebec, and four for direct connection to synchronous motors by the Lachine Rapids Hydraulic and Land Company—are believed to represent the successful development of arc lighting machinery along the lines which have been established as approved practice in direct current and alternating work.

Now that the waterworks are assured for Port Colborne, Ont., an agitation is on foot for electric light.

MANAGER LEATHER, of the Hamilton Radial Electrical Railway, says his line will be extended to Bronte by May 1. The railway has been built into Burlington.

THE Toronto & Hamilton Electric Co., successors to Kay Electrical Mfg. Co., reports that among recent sales are the following twenty machines to different parties · Hallman & Co., Berlin, one 12 h.p. motor; Toronto Cold Storage Co, one 50 lt. dynamo; *Journal* Printing Co., St. Catharines, Ont., one 5 h.p. motor; Geo. Membery, St. Catharines, Ont., one 3 h p. motor; Toronto Ornamental Iron Co., one 1,000 gal. plater; Meakins & Co., Hamilton, one 1 h.p. motor; R. N. Grundy, Guelph, one 200 gal. plater; Berlin, Ont., Felt Boot Co., one 150 lt. dynamo; Victoria Wheel Works, Galt, Ont., one 150 lt. dynamo; Messrs. A. R. Woodyatt & Co., Guelph, Ont., one 250 gal. plater; J. C. Harris, Toronto, one 7 h.p. motor; McKinnon Building, Toronto, one 2 h.p. and one 10 H. & P. direct connected motors and controllers; Garrioch & Goddard, Ottawa, one 2 h.p. and one 4 h.p. motor; Berlin Shirt and Collar Co., one 4 h.p. motor; D. W. Karn & Co., Woodstock, one automatic organ blowing machine, besides several machines in Victoria, B.C., and Woodstock, N.B.

A REPORT of the Commissioner of Inland Revenue dealing with the official inspection of weights and measures, gas and electric light, recently issued, contains sundry items of general interest. The progress which has been made in lighting by electricity is well illustrated by the statement that there were one hundred and eighty-seven electric light companies registered under the Inspection Act during the year ending on the thirtieth of June, 1897. The first in importance, measured by the number of lamps in use, and reckoning each arc light as equal to ten incandescent, is the Royal Electric Company, of Montreal, which heads the list with 1,450 arc and 58,000 incandescent lights, or a total equivalent to 72,500. The Ottawa Electric Company comes next with 550 arc and 57,240 incandescent lights respectively, or a total of 62,740. Third on the list is the Toronto Electric Light Company, with 1,400 arc and 45,000 incandescent lights, or a total of 59,000. The Montmorency Electric Power Company, of Quebec, follows with a total of 17,080 below which the figures decline rapidly. Contrary to what might reasonably be expected, only one company, and that with an evidently very limited patronage, is registered at Winnipeg. During the year 3,208 electric light meters were presented for verification. Of these, 3,111 were passed, "as coming within the error tolerated by law," 698 are tabulated as actually "correct," and 1,633 others of these "verified" meters are classed as "fast."

FROM the plant which the West Kootenay Electric Light and Power Company is erecting at Bonnington Falls, B.C., it is expected that transmission of power to the Rossland mines will be commenced early in February. Robert Jamieson is general manager and engineer for the company. L. A. Campbell, engineer of the Canadian General Electric Company, is erecting the generators at the power plant. Bonnington Falls, where the power house is located, lies about 11 miles below Nelson, B.C., on the Kootenay River. Water is conducted to the reservoir from the river by a canal 22 feet deep, cut out of the rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base. It extends across the fore-bay, some 54 feet, and is reinforced on the sides by abutments of concrete. The average rise of the Kootenay River is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used. The wheels, which are two in number, are of the twin horizontal type, manufactured by the Stillwell-Beirce-Smith-Vaile Company of Dayton, Ohio, and will develop 1,250 horse-power each, so that their united force is 2,500 horse-power. The turbine wheels are attached direct to the generators. There are two generators, having together a capacity of 2,500 horse-power, made by the Canadian General Electric Company, and of the three-phase revolving field type, wound to generate at a voltage of 1,040. They operate at 180 revolutions per minute. The exciters used in connection with the generators are operated by two separate turbine wheels. The step-up transformers increase the voltage from 1,040 to 20,000. The current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-station, which is situated on the Monte Cristo ground, is equipped with step-down transformers, which reduce the voltage from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines which will utilize electricity for motive power. At present it is not intended to use electric drills, but instead it will operate the compressors, and the compressed air will be used throughout the mine as at present. Oliver Durant, the general manager of the Centre Star Mining Co., is the president of the power company.

# Personal.

THOMAS J. LOCKE, of the Coast Railway engineering staff, has been appointed assistant engineer at Halifax, N.S.

R. B. MCCREARY has been appointed street engineer of Arnprior, at a salary of 30 cents per hour while on duty.

E. H. KEATING, C.E., city engineer, Toronto, has resigned to become manager of the Toronto Street Railway.

J. WOODMAN, Winnipeg, has been appointed engineer of the C.P.R, western division, *vice* D. A. Stewart, deceased.

JOHN MORROW, of the Machine Screw Company, Ingersoll, Ont., died last week, having been in ill health for two years.

W. J. SPROULE, assistant engineer to the Harbor Commissioners office, Montreal, has been elected mayor of St. Lambert, Que.

SIR CHARLES HUTTON GREGORY, the well-known engineer, and a former president of the Institution of Civil Engineers, Great Britain is dead.

H. W. TRUE has been appointed manager of the People's Heat and Light Co., Halifax, in succession to Peter Young, who goes to Pittsburg, Pa.

THOMAS MESTON, secretary-treasurer of the Hamilton Bridge Company, died at his home in Hamilton, Ont., a short time ago. He was 44 years of age.

THOMAS PETES was instantly killed at Steinhoff & Gordon's stave and hoop mill, Wallaceburg, Ont., a short time ago, by being caught in a shaft. The body was terribly mangled.

ST. ANDREW'S SOCIETY, Dundas, Ont., has been reorganized, John Bertram president. The president has been given the custody of a genuine Burns' snuff box of mahogany wood.

ON December 22nd, Harry A. Moore, B.A., superintendent of the Electric Light and Power Company, Trenton, Ont., was married to Miss Charlotte Greenwood, of Whitby, Ont.

R. EVANS, foreman of the Niagara Falls Metal Works machine shop, has gone to London, Eng., to take a position at $2,000 per annum. The metal works are being worked overtime at present.

T. F. FOLEY, of the firm of Holliday & Foley, of the Stratford, Ont., Bridge and Iron Works, extensive bridge builders, died recently of scarlet fever. He was an esteemed and popular young business man.

F. G. B ALLAN, superintendent of cement works, Napanee Mills, Ont., had a very severe shaking up lately by falling into the mixer. When rescued he was holding on to one of the arms of this tremendous machine.

P. A. DICKENSON, for a number of years head electrician of the Brantford, Ont., Electric and Operating Co., is leaving the city to engage in mining operations with the Mineral Point Mining Co., of Ashcroft, B.C.

T. MATTHEWS, while at work at the axle works, Woodstock, recently, met with a painful accident. A piece of steel flew from the hammer and struck him on the arm between the elbow and the wrist. It lodged about two inches deep in the flesh.

CAPT. WM. HALL, the superintendent of the Le Roi mine, Rossland, B.C., was killed, January 5th, by falling down the main shaft from the surface to the six hundred foot level. The body was terribly injured by the fall, and the remains were hardly recognizable.

DANIEL BOWERMAN, proprietor of Hallowell mills, about two miles east of Picton, Ont., was found dead in his mill last month. Marks of the cogs of a wheel were found on the side of his head. The wheel is supposed to have struck him while engaged in fixing the machinery.

ROBT. HEWITT, of the firm of R. Hewitt & Son, Phœnix Foundry Co, died at Markham Ont., a short time ago, of pneumonia, after a short illness. He was born in Cumberland county, England, in 1818, settled in Markham in 1855, and has conducted the business of the Phœnix Foundry for 30 years.

W. J. OLIVER, a pattern maker at the pulp mills at Sault Ste. Marie, Ont, crossed to the United States side one evening recently to attend a religious service. In going home he fell over the old Michigan canal bank to the lock chamber, a distance of fifty feet, and was killed. His family lives at Carleton Place, Ont.

FRANK RIDDELL, the foreman of the Imperial Oil Co.'s paraffine department at Petrolea, Ont., was presented a short time ago with a gold headed walking stick as a slight token of esteem by the employes. F. Ireland read the address, and W. Wilkinson made the presentation, while Bruce Dunlop acted as chairman.

An application for the city engineership of Toronto has been received from Stewart Howard, C.E., Montreal, who was formerly resident engineer in Toronto for the Northern Railway, and subsequently, while in the service of the C.P.R., designed and constructed the western entrance of that road into Montreal.

Arthur F. White has gone from Toronto to England. For the past two years Mr. White has been mechanical superintendent of the Hyslop tricycle factories, and was formerly lecturer in machine design on the Toronto Technical School staff. Mr. White has been engaged by a large firm in London, Eng., to install and operate a surveying plant, which he takes over with him from Hartford, Conn.

Jno. Hunter, brassfounder, Halifax, N.S., died last month. He was about 78 years of age and had spent about half a century in Halifax. For a good many years he carried on business on Sackville street, with his son Edward, but he first opened on Hollis street with Robert Wright as his partner. The deceased, who was a native of Glasgow, Scotland, was a citizen much respected by all classes, and his death will be deeply regretted.

George E. Drummond, of the Canada Iron Furnace Co., has returned from the old country, and one result of his trip is that considerable shipments of Canadian iron will be made to Great Britain and Germany. It is very gratifying to know that the superior qualities of Radnor Forges iron for special purposes are now acknowledged abroad as well as in Canada. Mr. Drummond confirms the reports that Canada now occupies a larger place in the mind and heart of Great Britain than it ever did before, and the next few years should see a large development in Anglo-Canadian trade.

The popularity of F. P. Brothers, late chief of construction of the Montreal Street Railway, was demonstrated shortly before he left for Jamaica, where he will superintend the building of a new line, by a banquet tendered him. The general manager, F. L. Wanklyn, presided, and covers were set for over a hundred, which included representatives from all the departments. The speech of the evening was made by Supt. McDonald, who, in the course of his remarks, said that he would use a strong and more electric expression concerning Mr. Brothers, by stating that their best affections had been permanently grounded by the magnetic currents of his well known business tact, his ability and genial friendship. The superintendent, amid great enthusiasm, then presented Mr. Brothers with a handsome traveling bag. Mr. Brothers, whose health was drunk with musical honors, received a great ovation. Short congratulatory speeches were also made by Messrs. Blackwale, president of the Canada Switch Co., J. Ross, Major Laurie, R. Chapman, John Garth, Landers, Carter and Swan.

# Marine News.

Lunenburg, N.S., is to have a marine railway. The boiler, engine, etc., are now on the ground.

Thomas Gale & Sons, Cumberland Bay, N.S., are building a schooner 77 feet long. John Parker & Sons, of the same place, are also building a woodboat, keel 61 feet.

The British Columbia Iron Works, Vancouver, B.C., have contracted to deliver two river steamers for the Hudson Bay Company, one in March, and the second on April 15th.

The Albion Iron Works, Victoria, B.C., have contracts for machinery for a number of vessels, including those for steamers which the C.P.N. Co. will place on the Yukon and Stickeen rivers.

As it will cost $20,000 to repair the steamer "Rosedale," its owners have abandoned it to the underwriters, who will hand it over to the Donnelly Wrecking Co., in payment for the work of saving the boat.

The first of the officers of the new Richelieu and Ontario Navigation Company's steamer "Toronto," has been appointed in the person of William Black, chief engineer of the steamer "Hamilton," who is to be chief engineer of the new boat.

The Polson Iron Works Company is preparing plans for a yacht for Timothy Eaton, Toronto. The boat will be 55 feet long by 8 feet beam, 3 feet 6 inches draught, and will run 16 miles an hour. It will have a steel frame and wood planking, and a triple expansion engine and tubular boiler. The yacht will be the handsomest boat on the Muskoka lakes.

Warren McCurdy, of St. Andrew's, N.B. has invented an electrical log. It is claimed to be accurate, not varying three-tenths between different trips recorded by it from light to light. The rotary log, instead of turning the line as in ordinary taffrail logs, communicates by a little cable with the steamer and registers in the captain's room. There can be dials, worked from the same log, in any part of the steamer.

A public meeting in Goderich, Ont., recently passed resolutions in favor of running a line of first-class steamers the coming season from Windsor to Sault Ste. Marie, calling at all the ports along the route.

Citizens of Annapolis, N.S., are forming a company to build a freight steamer to carry freight between Annapolis and St. John, N.B., calling at Bridgetown, Granville Ferry, Clementsport, Bear River and Digby.

Col. Anderson, of the Marine Department, Ottawa, was in Parry Sound not long ago, and visited Depot Harbor and Kilbear Point to inspect the locality for the Department with a view of building a new lighthouse at Kilbear, and range lights west of Kilbear and Depot Bay.

We have received a nicely got-up catalogue of boats fittings and appurtenances, to be had of the builder, Harold B. Rye, of Peterboro, Ont. He is perfectly familiar with all the details in the construction of a great variety of small boats, including family, pleasure and fishing skiffs; paddling, cruising and racing canoes; cat boats, etc. Those who are interested in the subject of prospecting canoes will do well to consult this catalogue, which gives the prices of many different styles.

The J. Bruce Hanly Engine Works, Midland, Ont., are building a 7 x 14 x 10-inch steeple compound engine for the Muskoka Navigation Company, Gravenhurst, and a 13 x 26 x 20-inch compound engine for James Playfair and Capt. Burke, who are themselves building the hull here for a general purpose tug. They are also overhauling a 18 x 36 x 32-inch steeple compound engine, re-boring cylinders, putting in new pistons, valve rods, etc., besides new brasses throughout. This is for the James Playfair Company, which is building the hull in their Midland shipyard, and intend her for open lake log towing.

Charles W. Ross, of the Railways and Canals Department, Ottawa, has secured a relic of some interest. It is a section of the mitre sill of an old canal lock built in 1780 by the Hudson Bay Company. The oak timber has therefore been for considerably over a hundred years under water, and yet is firm and solid. The section has not been touched by worms. The canal, which was half a mile in length, was built by the Hudson Bay Company to get past the Cascade Rapids in the St. Lawrence, but long since fell into disuse. It has a raise of about 13 feet, and contains three locks. The construction work was done by Col. Colter Mann.

Application will be made to the Parliament of Canada, at its next session, for an act to incorporate the Lake Superior and Rocky Mountains Navigation Company, to construct canals, from Lake Superior near Thunder Bay, thence following a chain of lakes and rivers across the height of land to Rainy Lake, and by way of Rainy River to the Lake of the Woods; from the Lake of the Woods along Rousseau River to the Red River; thence along Red River, Assiniboine River, Lake Manitoba and Lake Winnipegosis to Cedar Lake on the Saskatchewan River; or in the alternative from the Lake of the Woods by way of Winnipeg River, Lake Winnipeg and the Saskatchewan to the last mentioned point; and from Cedar Lake on the Saskatchewan River and Bow River to Calgary, in Alberta, and along its northern branch to Edmonton.

F. M. Rattenbury and others have given the contract to J. Stephens, of the Clyde shipyard, Victoria, B.C., for three new stern-wheeled steamers to ply on Lake Bennett. These vessels are to be ready for shipment north within thirty days. All three vessels will be stern-wheelers, 80 feet long, of 16 feet beam, and will have a draught of 18 inches when laden. They will be wooden boats and the machinery will be supplied by the Albion Iron Works. The contract for taking the hulls of the vessels into the lake will be distinct from that of either the furnishing of the machinery or the building of the hulls. A fourth steamer to be built at the Clyde yard will be a twin screw which J. Stephens has the contract from a Tacoma firm for constructing. It is intended for Teslin Lake.

A settlement has been effected between the parties in the suit of the Toronto Ferry Company for an injunction to restrain the city of Toronto from improving and maintaining the embankment protecting the intake pipe across the bay. This embankment caused stagnant water to accumulate in front of the Ferry Company's property and greatly depreciated it. By agreement the northern boundary of the Ferry Company's property is to be extended by means of piling to the conduit embankment opposite. The waterworks breakwater is to be extended southerly to the Ferry Company's property, and the area thus enclosed is to be filled in by the city with the sand pump. The city must undergo the expense of the piling, but the company must allow the city to use such piles on the eastern side of its property as become unnecessary by the proposed changes. The land thus made is to be used by the company in connection with their summer resort free of charges until the lease expires in the spring of 1901, when a renewal rent on a valuation basis shall be paid by the company. The company

on their part abandon all claims against the city for the silting up of their boat channel to the Point. They also forego all claims for past damages of any nature and consent to the issue of the order applied for to the Dominion Government, giving the city legal right to maintain the present embankment. Each party to the suit must sustain their own costs.

THE "Castilian," now building for H. & A. Allan, which will take her place on the Liverpool-Montreal route next spring, will have a registered tonnage of 8,800; her length will be 520 feet, and her beam 58 feet. She will have a speed of about fourteen and a half knots per hour, and passenger accommodation for 150 first cabin, 120 second cabin, and 800 steerage. The saloon, state rooms, and smoking room will be all located on the spar deck. The music room, which will be located on the bridge deck, will afford accommodation for a large number of passengers. The smoking room is arranged with easy chairs, divans and small tables for card parties. Besides her passenger accommodation, the "Castilian" will carry a large amount of freight. The freight accommodation will include refrigerators for perishable goods, and will be arranged so as to give different temperatures in the separate chambers.

# Railway Matters.

THE T., H. & B. have given the contract for repairing their rolling stock to the Waterous Company, Brantford, Ont.

APPLICATION is made to the Dominion Parliament for a charter for a railway from Hull, Que., or Montreal to Rupert Bay.

THE C.P.R. has closed a contract for fifteen compound locomotives. They will be heavy and of the most modern design.

H. R. RIDOUT & Co., railway supplies, Montreal, have dissolved partnership, and a new firm has registered, composed of Edward H. Seale.

W. RUSSELL & Co. have been given the work of building the Pembroke Southern Railway from Pembroke, Ont, to Golden Lake, where it makes connection with the O.A. & P.S.R.

A DEPUTATION consisting of Hon. R. R. Dobell, J. G. Scott and others waited on the Local Government recently, asking a charter to build a railway from Roberval to St. James' Bay, a distance of 300 miles, through a very rich country of the Lake St. John district. The assistance they ask is a grant of land.

A BILL to incorporate the Niagara Tramway Company, with a capital stock of $50,000, has been introduced in the Assembly of the State of New York. It is the intention of the company to string a wire across Niagara Falls and run a tramway from one side of the river to the other. It is designed to carry passengers and freight.

GEORGE GOODERHAM, W. R. Brock, Robert Davies, Hon. L. M. Jones and J. Herbert Mason, are members of the committee of disinterested and public-spirited citizens whom Mayor Shaw, of Toronto, acting upon the suggestion in the letter of T. G. Blackstock to *The World*, has induced to consent to handle the question of the city building a railway from Toronto to James' Bay. The question whether the present lines of the C.P.R. or the G.T.R. are to be utilized, or an entirely new line built, is the most important one the commission has to decide.

A DEPUTATION, representing the Commonwealth Mining Company, consisting of S. O. Shorey, J. C. Holden, Senator Thibaudeau, Montreal; J. R. Barber, Georgetown, Ont.; C. Riordon, Toronto; J. B. Powell, Nelson, B C., and others, waited on the Dominion Government recently. The company has a scheme for a stage line between Edmonton and Dawson City, in the Yukon, which they say can be traveled in about twelve days. The distance is about 1,500 miles. They propose to construct a trail all the way from Edmonton, and ask the Government to guarantee interest on bonds to the extent of $2,000 per mile for 1,500 miles.

THE Restigouche & Western Railway has completed arrangements for building the first 20 miles of the line. Malcolm & Ross are the contractors, and C. L. B. Miles is chief engineer. The road will be from the I.C.R., at Campbellton, N.B., to the St. John River at Grand Falls or St. Leonards, at either of which it connects with the C.P.R.; at St. Leonards also with the Bangor & Aristook Railway. By bridging the Restigouche at Campbellton, it will connect with the Atlantic & Lake Superior to Gaspe. There will be 110 miles to build, through heavy timber, spruce and cedar, in abundance, and some fine tracts of farm lands, on ridges covered now by a wealth of rock maple.

THE Canadian Pacific Railway and Auguste Heinze have come to terms, and the agreement is that the Trail smelter, the railway from Robson to Trail, the short line from Trail to Rossland, and the lands received from the British Columbia Government as subsidies, are handed over to the Canadian Pacific Railway for the sum of $800,000 The narrow gauge from Rossland to Trail will at once be widened to the standard by the new owners, who will also make the grades much easier. The line from Robson to Trail is a standard gauge, is well built, and can be operated at once in connection with the system to which it now belongs.

THE Ontario Government voted the following railway bonuses at the last session: To the Ontario and Rainy River Railway, from a point at the westerly end of the 165 miles heretofore aided to a point at or near Fort Frances, a distance not exceeding 40 miles, a cash subsidy of $3,000 a mile—$120,000. To the Pembroke Southern Railway, between Pembroke and Golden Lake, from a point in the north-east part of the township of Alice to the north-eastern boundary of the said township, a distance of 3½ miles, a cash subsidy of $3,000 a mile—$10,000. To the Irondale, Bancroft and Ottawa Railway, from a point 45 miles from Irondale, at the end of the portion of the railway to which aid was granted in 1896, and thence due east for a distance of 10 miles, a cash subsidy of $3,000 a mile—$30,000. To the Bay of Quinte Railway, for such extension or branches of its projected and authorized line of railway north of the village of Tweed, as will not exceed thirty miles in all, and will enable the said company to connect its existing railway with the iron ore deposits lying northward of the said village of Tweed, in renewal of the amount granted to the Kingston, Napanee and Western Railway in the year 1893, a cash subsidy of $3,000 a mile—$90,000. To the James' Bay Railway, to aid in the construction of ninety miles of the said railway from Parry Sound to a point at or near Sudbury, $3,000 a mile for a distance not exceeding 40 miles ($120,000), and the unearned subsidy of $3,000 a mile for a distance not exceeding 50 miles, which was granted to the Nipissing and James' Bay Railway in 1889, which said unearned subsidy is hereby transferred to the James Bay Railway. (New vote, $120,000; transferred from other road, $150,000)—$270,000.

# Mining Matters.

ACTIVE operations are going on at present in the Darling iron mine, Lanark County, Ont. Five thousand tons have already been taken out.

J. H. S. CASS, who is well known to the asbestos trade, is now carrying on business as the Cass Asbestos Mining Co., 97 St. James street, Montreal.

HALIFAX, N.S., papers have recently contained references to the reputed discovery of rich gold fields in Labrador. Some are said to rival the Klondyke in richness, but the reports are without confirmation.

AT a preliminary meeting of the B. C. Association of Mining Engineers, held in A. H. Holdich's office, Rossland, a month ago, a paper on mining laws by G. F. Moncklon, Esq., of Vancouver, was read and discussed.

A NEW oil field promises to be opened at Point Edward, Ont. A test well has been put down, and oil struck at a depth of five hundred and forty-five feet. A company has been formed, and they intend sinking more wells at once.

THE negotiations between Sir William Van Horne and T. G. Shaughnessey, of the C.P.R., and Heinze and Warfield in reference to the purchase by the C.P.R. of Aug. Heinze's railway and smelter in Kootenay, have been practically concluded, and it can be stated that the property in question has been transferred to the C.P.R. interest.

ARCHIBALD BLUE, Ontario Department of Mines, was recently interviewed by Messrs. Ashworth and Murray, of Sault Ste. Marie. They took up a claim in the Michipicoten district, and sunk a fifty-foot shaft. They report having struck a vein eight feet wide and nine feet deep, at a depth of fifty feet, which assayed $32 to the ton.

TWO gold bricks from the Saw Bill mine have been on exhibition at Port Arthur, Ontario, recently. Their combined weight is 13½ lbs, and they are the result of 20 days running of the mill, crushing an average of 20 tons per day. Manager Wiley says that putting in a 20-stamp mill will double the output of the mine, and only requires the services of half a dozen more men.

THE following have organized the Northern Yukon-Klondyke Mining Company, Limited: Hon. G. Bryson, jr., Fort Coulonge, Que.; J. Gillies, D. Gillies, M.P.P., Carleton Place, Ont.; W. Gillies, of the said place; J B. Fraser, Ottawa; J. B. MacLaren, Buckingham, Que.; A. MacLaren, Buckingham; J. C. Cox, Liverpool, Eng.; J. H. Francis and G. F. Francis, Pakenham, Ont.; J. W. Bryson, Fort Coulonge; W. H. A. Fraser, Westmeath, Ont.; H. Aylen, Ottawa; J. G. MacLaren, Ottawa; J. E. H. Barnet, Renfrew, Ont.

Wm Blackmore, chief manager of the Crow's Nest Pass Coal Co., was in Montreal recently, and will leave for the scene of the company's operations at Coal Creek. Mr. Blackmore has visited the leading mining centres in Canada and the United States, and with the result that the most improved electric coal cutting machinery will be started in the Pass mines. Orders for machinery have already been given out in Montreal, Toronto and elsewhere to the value of $100,000, while the company will erect about fifty beehive cooking ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B.C.

H. L. Simmons has purchased twenty acres near Nakusp, B.C., for a smelter site, and has also secured the water rights in that vicinity for the use of the proposed smelter. It will, it is said, be a plant similar in some respects to the one at Trail. It is thought at Nakusp that Mr. Simmons is connected with the parties who are about to erect a smelter at Vancouver. This company, it is claimed, intends to erect smelters at several points in the Kootenay country, and to send the product of these plants to the central refinery, at Vancouver, for separation into the several metals that are in the matte.

The following papers and subjects were presented and discussed at the meeting of the British Columbia Association of Mining Engineers, held in Badminton Hotel, Vancouver, a short time ago: "Notes on Mining Law and its Application to Mines and Mining Districts," by Frank C. Loring, M.E., Rossland; "The Possibilities of Smelting in British Columbia," by Robert R. Hedley, Nelson; "Notes on Southwest Kootenay Ore Bodies," by J. C. Gwillim, B.A. Sc., M.E., Slocan City; "Odd Notes on Mining," by A. H. Holdich, Nelson; "Mining Machinery in the Slocan," by Howard West, A.R.S.M., New Denver.

A shareholder of the famous Le Roi mine received a letter from Rossland recently containing the following details regarding that great property: The mine continues to ship about 200 tons of ore per day to the Northport smelter. Recent returns show that the ore is going about 1.54 ounces in gold, 4 per cent. copper, and 3 ounces of silver; its monetary value being itemized as follows: Gold, 1.54 ounces at $20, or equal to $30.80; silver, 3 ounces at 57 cents, equal to $1.71; copper, 4 per cent. (80 lbs.)at 10¾ cents, equal to $8.60, or a total of $41.11. Estimating the product of the mine at 200 tons per day, the gross value of the ore raised daily is $8,222, or $246,000 per month, which in turn makes the gross yearly product of Le Roi mine $2,959 920.

Reserve—Cassiar District.—Notice is hereby given that the under-mentioned tracts of land are reserved for Government purposes until further notice, viz.: 1. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Bennett Lake which lies within the province. 2. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Teslin Lake which lies within the province. 3. A belt of land commencing at a point five miles below Glenora, on the Stikine River; thence up the said river to a point five miles above Telegraph Creek, and having a width of five miles on each side of the said river. —Geo. B. Martin, Chief Commissioner of Lands and Works for the Province of British Columbia.

At a meeting of the Peninsula Mining and Development Company, Limited, held at Windsor, Ont., Jan. 15th, all arrangements were made by the company for their expedition to the Klondyke, which will leave Windsor on February 15th, under the management of Major J. E. Johnson, of Leamington, Ont. The following gentlemen will accompany the Major: C. A. Hugheson, Ouvery; J. C. Burk, Blenheim; M. Toll, Ouvery; J. Coyne, Leamington; B. Noble, Leamington; D. Noble, Northridge; William Johnson, Essex; J. Lickman, Essex; J. C. Myres, Cottam; C. McApe, Cottam; J. Imeson, Wheatley; R. F. Leeming, Kingsville; D. Edwards, Coatsworth; F. Dawson, Coatsworth; Thomas Dancey, Coatsworth; W. Toll, George Lawrence, J. B. Lawrence, Blenheim. The expedition will go by Edmonton, and expects to reach the Yukon district in about two months.

An incident of great interest to the mining district of North Hastings, Ont., took place lately at the Belmont mine, near Marmora, Ont., now being operated by the Cordova Exploration Company, Limited, of Newcastle-on-Tyne, England, which was the official opening of the company's new stamp mill by Miss Grace Carscallen, daughter of A. W. Carscallen, M.P., who formerly owned and developed the property. The opening took place in the presence of a number of persons who had been invited by the general manager, David G. Kerr, Glasgow, Scotland, late superintendent of one of the mines of the same company in Norway, who came to take charge of the property on the 15th of August last. The mill was erected and the machinery built and put in place by the Wm. Hamilton Mfg. Co., Limited, of Peterboro, and speaks well for this firm, who are so widely and favorably known throughout the Dominion as mining machinery manufacturers. The construction was under the supervision of Richard Proutt, of Marmora. After the ceremony of opening and inspection was over, and after visiting the Assay Office, which is in charge of George Hardy, chemist, of Newcastle-on-Tyne, a young employee of the Cordova Exploration Company, the party were entertained to a sumptuous repast at the manager's residence.

## THE ONTARIO RE-FORESTING COMMISSION.

During the recent session of the Ontario Legislature, the Commissioner of Crown Lands laid on the table the report of the Royal Commission appointed in June last to investigate the subject of "restoring and preserving the growth of white pine upon lands in the Province, which have been cleared or partially cleared by lumbering operations or by fire, and which are not adapted for agricultural purposes or for settlement." The commission consisted of E. W. Rathbun, president of the Rathbun Lumber Co.; John Bertram, president of the Collins Inlet Lumber Co.; J. B. McWilliams, superintendent of Forest Rangers; Alex. Kirkwood, of the Ontario Crown Lands Department and Thomas Southworth, Clerk of Forestry.

During the fall and summer the members of the commission visited the townships of Smith, Harvey, Galway and Burleigh, in the county of Peterboro; the territory along the north shore of Lake Nipissing, and down the Vermilion River, in the township of Louise; the country around Thessalon, Algoma Mills and Killarney; the townships of Carlyle and Humboldt, and other points on the north shore of Georgian Bay and in the neighborhood of Georgian Bay. The commissioners also inspected some of the territory on the north shore of Lake Superior and the country along the line of the Port Arthur, Duluth & Western Railway west of Port Arthur, in addition to taking a somewhat extensive trip through the Rainy River country, visiting also portions of the northern parts of Minnesota and Michigan in the United States.

Though the commission has not yet had time to examine minutely enough into local conditions to be able to submit detailed plans for the care and management of the areas visited, yet its investigations have been of a sufficiently technical nature to warrant them in coming to the conclusion that with sufficient areas set aside for the purpose, and with reasonable care and protection of the young and growing timber now upon them, the supply of merchantable timber in the Province of Ontario will be vastly augmented. The commissioners next score lumbermen for the reckless maner in which they have treated our forests. The former apparently limitless forest wealth of the province has led them to be incautious as to the safety of the forests, and the litter they have left lying about has fed the destructive fires that have always followed. These fires have destroyed the original growth, and in many cases paved the way for the springing up of a crop of other varieties more easily propagated. It has been found, however, that where any of the original trees survived the fire and produced seeds, the forest has eventually assumed the characteristics of the growth indigenous to the locality. The widely-entertained theory that the white pine on being cut away is invariably and permanently succeeded by a crop of inferior varieties, was completely disproved by the frequent instances observed in which tracts of flourishing young pine trees are growing up on cut-over land, and the prevalence of the idea can only be accounted for on the ground that fire has in so many cases completely exterminated the pine in all stages of growth. There seems to be no doubt that with the exclusion of fire, and the adoption of more intelligent and provident methods of lumbering, there would be no difficulty in securing a quick and sure production of the varieties of trees desired.

As a rule, after the fires the seeds of the aspen, poplar, birches and cotton woods, which are carried great distances by the wind, soon cover the burned-over area, and a vigorous crop of these varieties springs up, and speedily occupies the ground. In most cases, however, a few pines have managed to survive the fire, and where this is the case their seeds are scattered and soon supplant the poplars and other inferior growths. In looking casually over one of these devastated tracts, the first impression conveyed is that poplar and other deciduous trees form the sole vegetation, but a closer inspection will reveal the presence of a large stock of young conifers, which in time will outgrow and drive the poplars into decadence. The commissioners put forward as an example of what results might be obtained, the township of Burleigh, in the county of Peterboro. The cutting of timber began here 50 years ago, the original forest being chiefly of excellent pine. About 33 years ago a colonization road was run through the township, and since then the lumbermen and the fires started by settlers have devastated the forest on the west side of a stream known as Eel's Creek. The frequent fires have burned over a large part of the soil and killed any pines that may have been left by the lumbermen, so that any national reforestation would be a very slow process.

Now, for the other picture. The east side of Eel's Creek presents an altogether different aspect. Viewed from the Burleigh road, it has the appearance of a thrifty young poplar forest, with a few young pine trees appearing on a level with the poplar. On closer examination, it was found that the young forest was largely composed of red and white pine. It was moreover learned that this portion of the forest had not been visited by fire since twenty-three years ago. The pines will, if protected from fire, soon overtop the poplars and assert the supremacy of their species. The conclusion arrived at was that within fifty years lumbering operations in this locality could be profitably resumed and the larger pine trees taken out, producing timber of a merchantable quality, and giving the younger trees a better chance to grow. Reasonably good forest conditions could, under proper regulations for cutting, be introduced and a continuous supply kept up. This statement as to the condition in the township of Burleigh may be taken as fairly typical of the course of natural forest regeneration in nearly all the fire-swept lands which came under the observance of the commissioners. Much of the forest lands now looked upon as of little use will yet, under proper protection, be very productive. The main feature of forest preservation must be protection from fire.

To the north of the height of land which sheds water into Hudson Bay, it was found that some timber lands had been burned over through the carelessness of Indians, but the Hudson Bay officials there had promised to help the Government in protecting the forests. The commissioners proceed to say that, though in earlier years the lumbermen confined their operations to taking out trees which measured at least 14 inches diameter at the butt, many rafts were observed to-day to consist of mere poles--six inches or so in diameter. This practice should be promptly stopped by the Government.

The commissioners give the following idea of the rate of growth of white pine: A young tree which would cut only one log 8 inches in diameter and 16 feet long, measuring 16 feet, board measure, would, if allowed to stand for thirty years, grow in diameter at the rate of one inch in five years – in some cases the growth is an inch in two years—and hence would give a butt of 14 inches diameter, 16 feet long, or 100 feet of lumber, board measure. In addition to this, however, this tree would have grown in height sufficiently to give two more logs, one, say of 11-inch, and one of 8-inch diameter, both 16 feet long, or a total of 164 feet, board measure, for the tree. Thus, a tree that required, perhaps, 40 years to make its first 16 feet of merchantable timber would in 30 years more have increased to 164 feet.

The commission suggests that a market should be secured for the "thinnings," which should be taken out where the timber stands too thick, and the idea is put forward that much of this apparently useless forest material might be utilized in the manufacture of pulp and small wood goods, or for the production of charcoal for smelting ores.

In conclusion, the commissioner recommends that—

1. The present system of fire ranging inaugurated by the Government in 1886 be extended so as to be compulsory on all the holders of timber berths; that all unlicensed timber land contiguous thereto be also protected by rangers employed by the Government, and that all fire rangers be subjected to the inspection and control of the Department of Crown Lands.

2. That the officials of the Hudson Bay Company be asked to co-operate with the Government in preparing and printing fire proclamations in the language of the Indians of the northern districts, to be posted along the canoe routes throughout the country.

3. That for all unworked limits on which the ground rent shall be two years in default on the termination of the present license year, the license shall not be renewed, but the berths be held by the Crown as forest reserves.

4. That license-holders be not allowed to cut any trees for logs smaller than will measure 12 inches across the stump, two feet from the ground, unless under special forest conditions, with the sanction and under the supervision of the district forest ranger.

5. That the Government take power by Order-in-Council to withdraw from sale a location, and set aside, to be left in permanent Crown forest reserves, such areas of territory as are generally unsuitable for settlement, and yet valuable for growing timber.

## FIRES OF THE MONTH.

Jan. 12th—North-West Elevator Co.'s elevator, Cypress River, Man.; partly insured. — Jan. 13th—The Dominion Paper Box Co.'s building, Adelaide street, Toronto; loss, $50,000.——Jan. 17th—A. Merizzi's woolen mill, Napierville, Que; loss, $10,000.——Jan. 21st—Richelieu and Ontario Co.'s office, Montreal; damages, $800.——Jan. 23rd—The power house and car house of the Metropolitan Street Railway Co., Toronto; damages, $10,000; fully insured.——Feb. 1st—The Doherty organ factory, Clinton, Ont.; damages, $75,000, insurance, $35,000.

—J. H. Still promises to have the St. Thomas electric street railway in operation before Dominion Day.

—The voting on a $25,000 system of waterworks for Mount Forest, Ont., took place January 20th, and resulted in the by-law being sustained by a majority of 49.

—The trustees of Havergal Ladies' College, Toronto, have taken out a permit for the erection of a three-story brick school building at 356 Jarvis street, to cost $35,000.

—Edward Hooper, Toronto, has taken out a permit for the erection of a five-story brick addition to the Grand Union Hotel at the corner of Front and Simcoe streets, Toronto, to cost $30,000.

—The Ontario Wind Engine and Pump Company has taken out a permit to erect a two-story brick machine shop and office at the south-west corner of Atlantic avenue and Liberty street, Toronto, to cost $3,000.

—It is stated upon good authority that the H., G. & B. electric railway will be run through to St. Catharines if the Decew Falls power scheme proves a success, so that the company can get power from that source.

—In view of the Canadian Pacific's decision to bring Toronto business round by Carleton Place a large number of new locomotives will be put into service on the line, orders for some forty new engines being now in the hands of locomotive builders.

—The Polson Iron Works Company, Toronto, has secured the contract from an English syndicate for the building of a steamer to be used on the Yukon River. She will be a stern-wheeler, dimensions 45 feet long and 9 feet beam, and will draw only 15 inches of water.

—The Ontario Government granted the sum of $35,000 towards the construction of an International railway bridge across the river St. Lawrence, at Cornwall, on the line of the Ottawa and New York Railway; provided that aid be granted also by the Government of Canada.

—A big scheme is on hand for the incorporation of the Montreal and Champlain Canal Co., which proposes to construct a canal from the St. Lawrence to the Richelieu River, a distance of 18 miles. The company is to have a capital of $6,000,000. Albert J. Corriveau is the promoter.

—There was a general strike of men employed by the Canadian Pacific Navigation steamers in British Columbia, February 2nd. They demanded an increase in wages in view of the rush to the Klondyke. Some of the strikers were placed under arrest charged with violating the laws governing the sailing of vessels. They appeared before the magistrate, who gave them the choice of going to work or jail. They chose the former.

—The annual report has been issued of the Niagara Falls Park & River Railway. The report shows the number of passengers carried is away ahead of previous years. In 1896 the passengers carried numbered 497,000; in 1897 the number carried was 579,000, giving to the year 1897 an increase of 82,363 passengers over 1896. The Niagara Falls Park & River Railway was established in 1893, and has been a success ever since its inception. W. Phillips, who has completed his first year as acting manager of the road, was appointed general manager at an increased salary.

—The second inter-provincial conference of Canadian mining engineers and mine managers will be held in Montreal, under the auspices of the Federated Canadian Mining Institute, commencing Tuesday, March 1, and continuing the three following days. Some forty papers will be read and discussed by the members of the association. The proceedings of the conference, which will take place in the ladies' ordinary and other rooms of the Windsor Hotel, will be open to the public. The annual banquet of the association will be held at the Windsor Hotel on the evening of Thursday, March 3rd.

—Although little or nothing has been said about it, the Chateauguay and Northern, or, as it is better known, the Bout de l'Ile Electric Railway Company, has done a very considerable amount of construction work during the season past. The system has been connected with the Canadian Pacific Railway freight yards, on Moreau street, Montreal, the meeting of the two roads being effected near the old North Shore freight office. This new branch, which brings the Chateauguay and Northern into immediate connection with the C P.R., embraces about 1½ miles of track, the rails being 60 lbs. to the yard, and extending all the way from Lasalle street to the Canadian Pacific yards, just mentioned, so that goods can now be billed from any part of the C.P.R. to any point on the electric road in question.

## THE KNAPP ROLLER BOAT.

*Editor* CANADIAN ENGINEER :

SIR,—Now that the Knapp boat is laid up for the winter without a speed trial, it may be of interest to consider some of the points which have been made against her success. Foremost among these is the great wind question. It is claimed that wind pressure reduces the speed of the " Campania " from 560 to 180 knots a day. Is this the whole truth? I think not. A vessel of that class is submerged about 33 feet, or nearly two-thirds of her entire bulk. The air, through which the smaller portion of the vessel has to make its way, is some 700 times lighter than the water which resists the submerged portion. But the water in a high head or quarter wind acquires under the influence of the wind, a very rapid motion. This rapidly-moving water, weighing hundreds of tons, is hurled against the bows of the on-coming vessel. A vastly lighter body of air is at the same time opposing her upper works. But which has the greater effect in reducing her speed? Obviously 700 tons of water will retard her speed more than one ton of air. It is probable, may we not say certain, then, that the " Campania's" speed is reduced, not by the wind pressure on her upper works, but by the resistance of the rapidly-moving water against the submerged portion of her hull. The wind pressure in itself can add but very little to the retardation.

Now, discarding all other elements but those of water resistance, how will this affect the full-sized Knapp boat? To begin with, the immersion will be considerably less than one-half that of the ' Campania." The serious resistance will therefore be diminish ' in that proportion. But this is not all advantage to the Knapp boat. The trials have shown that increase of water resistance produces increase of speed, thus completely reversing present conditions. The weight of water flung against the submerged portion, which is curving downwards and away from the on-coming wave, will tend to "sweep her legs from under her," just as a beam sea causes the staunchest boat to roll. But to roll is just what Mr. Knapp's boat is built to do. Consequently this terrible foe of present-day craft will be an actual friend to the new monster.

But how about the wind on the upper works? Here, indeed, there is a tremendous increase of surface to play upon. But here also another principle appears which may very possibly surprise the cock-sure prophets. If two moving bodies meet, the lighter of the two will be inevitably overcome by the heavier. Now the Knapp boat will weigh some 15,000 tons, and will present 112,500 square feet to the wind, less the submerged portion. Now in calm weather, at a speed of a mile a minute, the heaviest pressure of wind would be about 18 lbs. to the square foot, or, adding the resistance of a 40-mile gale, about 26 lbs. to the square foot. The weight of wind to be encountered would thus be about 1.012 tons in calm weather, or 1,462 tons in a 40-mile gale. What will happen to that 1,462 tons when 15,000 tons are thrown forcibly against it at the rate of a mile a minute? Which must give way? I imagine there can be no two answers to this problem.

But very competent engineers think that the surface presented to the wind would be more accurately represented by multiplying the length by one-half the diameter, for the reason that the shape of the boat and its peculiar motion would greatly reduce the retarding effect of the wind upon it. If this be admitted, the pressures given above must be divided by two, giving 506 tons wind resistance in calm weather, or 731 tons in a 40-mile gale, and with the boat going at a mile a minute. It will be seen, therefore, that everything against the boat is conceded in the above argument, while in what I am about to say I shall concede everything in favor of my examples.

It will doubtless be objected that the horse-power necessary to drive that 15,000 tons against 1,462 tons at the rate of 5,280 feet a minute will be so enormous that the boat could never carry it. To this the inventor replies that the momentum of his boat will be in itself sufficient to overcome wind resistance, and all his engines need do is to roll his boat *in* the water at that speed. The weight of the boat and the aid of the resisting water will do the rest. But we are told "there is nothing in momentum." Fortunately that fact can be tested, because ships are not the only moving bodies which are confronted with wind resistance. Let us take then as a test the Holman engine, which recently ran at the rate of a mile in 28 seconds for a short distance, and made the whole mile in 32 seconds, or the Empire State express, which has a record of 34 seconds for a mile. It is noticeable in both cases that a long run was made first, in order to "get up speed;" in other words, to acquire momentum. The Empire State express traveled 17 miles for this purpose; the Holman engine, 3 miles. Both present approximately 120 square feet of area when driving directly against the wind. If the wind is slightly on the quarter, this area would be much increased. But let us take the smallest area for our purpose. Taking the speed at two miles an hour the wind pressure would be 4 1-3 tons upon the square surface area of the train, head on. Reduced to horse-power, this would be roughly 3,000 h.p. But the engine actually possesses only about 1,500 h.p., and this is mainly used in overcoming the mechanical resistance of the inertia of the train, and all the friction of the machinery. Here, then, is a problem for objectors. It is evident that power is required merely to move the train. It is also evident that the engine does not possess sufficient horse-power to overcome the wind resistance alone, as ordinarily calculated. Whence then does the power come that not only moves the train, but overcomes the wind pressure also, and speeds along at a rate of a little under or over two miles a minute? Mr. Knapp says it is gained from the momentum. The engineers say there is nothing in momentum, but they do not answer this curious problem. Until they can it is at least possible, perhaps even probable, that Mr. Knapp is right. What you say in your July number as to the limitation of the effective power of the engines is admitted by Mr. Knapp to be true, and he has all along objected that this was a wasteful mode of applying the power. He wishes to apply it direct to the axle by the action of cranks.

I may add that I know the inventor well, and have constantly discussed the boat with him for the last three years. I do not wish him to be held responsible, however, for anything I have said except when it is directly attributed to him.

ONE OF THOSE INTERESTED.

Kingston, Dec., 1897.

NOTE.—The writer of the above letter has, in starting out, evidently confused wave motion with current. If he goes out on Lake Ontario after a storm, when a dead swell is on, and drops a stick on the water, he will find that though the waves heave ever so high the stick does not move away, but swings back and forward with each undulation. Even in a gale the surface water blown along by the wind is only a shallow "skim," and never keeps pace with the undulations of the waves. All the arguments built on this misconception fall to the ground. and need not be discussed. The writer asks, "What will become of that 1,462 tons (wind pressure) when 15,000 tons (weight of boat) are thrown against it?" One might answer that question by asking what will become of the roller boat when, with motive power limited to the slight leverage obtained by the weight of the internal machinery, it is exposed with its 112,500 square feet of surface to a howling gale? Our correspondent talks of the momentum of his boat overcoming the wind resistance, but how will he get his momentum without power? And power he has not got, and cannot get a boat on this plan. He is equally wrong in his speculations on the speed of a railway train. It is power, and not momentum, that enables a train to get into motion on an up-grade against a gale of wind. A gentleman of wide experience and good judgment, both on marine and mechanical questions, and who has studied Mr. Knapp's boat, is of opinion that three to six miles per hour is all she is capable of even in a comparative calm. With regard to the arguments used by "One of those Interested," he says:

" The supposition that the movement of the water against the direction of the vessel would help it to go ahead is absurd. The current of a river would be analogous to such a movement of water (if it existed). Therefore, if the Knapp boat was rolling up a river, the more rapid the river the faster the boat would run up it! The certainty is that the same law would hold good as in the case of any vessel. The speed up the river along the land would be the ordinary speed of the boat in calm water, minus the miles per hour of the current against it. The illustration is given of a beam sea causing a boat to roll. But a beam sea rolls the boat away from the wave, not towards it. With reference to the action of wind on the upper works, the proposition is made that if two moving

bodies meet, the lighter will be overcome by the heavier. Quite so, but the speed of the heavier will be diminished in proportion to the weight of the lighter. Therefore, the heavier the wind the slower the boat working against it, and, of course, the larger the surface acted upon the greater the retardation. The error here is on assuming that the weight of the boat (15,000 tons) is any factor. It is not the weight of the boat versus the wind, but the power of the engines, whatever that may be, versus the power of the wind, with the uneven surface to act upon. But the success of the new departure must be judged by results. Taking the power put into the boat, the manner of its application, and the resistance of the peculiar form of the hull into consideration, it was estimated by experts and practical men that the speed in still water would be about four miles per hour. This at the experimental trials proved to be the limit, thus demonstrating the accuracy of the calculations. The same power on a similar displacement with a scientifically-shaped hull would have developed about 15 miles at least. But supposing a reasonable amount of speed had been obtained, what then? The monstrosity is incapable of fulfilling any one of the ordinary requirements of navigation. There can be no accommodation for passengers. It would be impossible to carry cargo in such a shape that it would not be ground to powder as it was rolled around. The vessel could not be brought to an anchor, if it became necessary. In fact a more utterly unpractical form of ship could not be devised, even if the inventor had had that in view as the sole object of his labors.

A contingency that the inventor cannot have considered as he talks of a mile a minute, and that is that at this speed, allowing 20 per cent. slip, the 20-foot hull would have to revolve 100 revolutions per minute, at which speed the centrifugal force would send the cargo through the ship's bottom, and if not accurately balanced, would shake the vessel to pieces.

In an interview with one of the Toronto papers, Mr. Knapp said he would not attempt to steam against a gale, but as winds move in cyclones where diameter is never more than 400 miles, he would just roll out of the boundary of one of these cyclones, and then go on. R. F. Stupart, Director of the Meteorological Service, has some knowledge of the character and extent of cyclonic movements of wind, and in reply to an enquiry on this matter, Mr. Stupart says: "It sometimes happens that severe tropical cyclones are not more than 400 miles in diameter, and sometimes considerably less; it is seldom, however, that the storms occurring on the trans-Atlantic and Pacific routes are less than 1,000 miles in diameter, and frequently they are much more. A southerly gale in advance of a storm centre will oftentimes begin to blow near the coast of Ireland, while in the rear of the same storm centre a north-westerly gale is still blowing off the coast of Newfoundland. As these storms do not progress eastward at a greater average rate than 30 miles per hour, it will doubtless be possible for the roller boat when it acquires a speed of *sixty miles per hour*, to keep out of the bad weather."

## ELEVATORS, HYDRAULIC V. ELECTRIC.

*Editor* CANADIAN ENGINEER:

In your January issue, P. W. Moses, consulting electrical engineer, of New York, takes exception to some of the statements in the article on elevators in the December issue. I can not see where Mr. Moses proves my statements to be incorrect, and therefore it is difficult to answer him. Also he is an expert, and the article was written for an engineer like myself, and I feel flattered that it was of such moment that it was taken up by a New York electrical engineer, but as Mr. Moses has given his opinion, I will try to follow him, and simply repeat what I stated before, and what are practical facts.

In the first place, I do know more about hydraulic than electrical elevators. I am as well acquainted with electrical elevators as I care to be, and I very likely know a great deal more about the generating end of the electrical plant than Mr. Moses does; not theoretically, but practically. It is easy to figure on any subject, but figures are not what we pay for: it is coal, oil, and repairs, with labor, interest, etc. Mr. Moses says that an engine and generator can be put in for $5,000. It can, but it is not enough, and will not purchase a plant large enough for five elevators, let alone a duplicate plant, whereas a first-class compound pumping engine can be put in in duplicate large enough for five elevators for the sum of $5,000, and if the architect put in an electric generating plant in keeping with the rest of the building, it would not be a one-horse show that could be purchased for $5,000. I know what it costs to install generating apparatus, also hydraulic elevators, and if the proper specifications were got out, and the manufacturers thought that they would get a fair show, the five elevators could be installed in a first-class manner with pumping machinery, for $30,000. The elevators, if electric, cannot run off the lighting engines satisfactorily; no matter what Mr. Moses thinks, it is very seldom done, except in very large stations or where they have only one elevator.

In the matter of safety, Mr. Moses proves just what I stated, namely, that the electric is more complicated, which does not tend to safety, but is dangerous, for the electric devices that you are depending on often fail to work when you want them, because the current is off. He says that there is not an elaborate cycle of changes during the time of starting, and then goes on to describe the very changes I spoke of. The electric man says that all you have to do is to push the button in the car and it starts, but just trace out all that occurs from the time the button was pushed until the car was at full speed. Then watch the hydraulic apparatus. You move the hand-wheel and it moves the valve direct. Nothing could be simpler, but the electric is simple enough to anyone looking through electric spectacles. Mr. Moses says that the electric elevator does not appear complicated. It does not appear so, but it is very complicated. Just the same in comparison with hydraulic. Even when he compares the electric elevator with the hod-hoist, which, by the way, I think is an apt comparison. He states that they are in use in hundreds of New York buildings, and receive the least possible care and attention. That may be one of the reasons that they run so badly; or they may get the least possible care, and yet, that least possible may mean a great deal of work. A gentleman went to New York to look into elevators before installing a large plant, and everywhere that they had hydraulic the practical men around the plant spoke well of them, and where they had been electric, almost invariably they were dissatisfied, and said, "put in hydraulic by all means."

Mr. Moses also says that the comparative wear and tear is yet to be determined. It may be by Mr. Moses, but I can cite cases in Montreal, Buffalo, and Toronto, where electric elevators cost more for worn out parts in the first six months than any hydraulic would in two years, and he acknowledges that the life is shorter for the generating apparatus, and as that generating apparatus costs more than three times what the same size pumping plant would cost, it does matter a great deal. I will not go into figures, as I can prove by figures that the electric is the more economic as far as coal is concerned, but I also know that it costs more for repairs on certain electric elevators than it costs for current, and when material and labor are taken into account, the economy is on the side of the hydraulic.

I again make the statement that the plant should be the full capacity of the five elevators, and my practical experience as engineer of the Incandescent Light Company proves that, and anything short would be folly. My experience there proved to me also that nearly all the complaints from customers were due to elevators coming on when the load was light, and the company has since put them all on a separate circuit, thereby improving the lighting system wonderfully. When the load is heavy, the elevator adds such a small percentage that the effect is not noticed That is why the New York companies can run the electric elevator with practically no effect, as their load is heavy all the time.

In conclusion, I know more about the condition of Toronto and its City Hall than Mr. Moses does, and I could prove even to Mr. Moses that hydraulic elevators is what the City Hall should have, if he were anything but an electrical engineer. One of the proofs in the previous article was, that all the manufacturers making both kinds of elevators says they should be hydraulic, and only one, who makes only electric elevators, says they should be electric, and of necessity electrical engineers would say the same. Mr. Moses knows more about electricity than I do, no doubt, but he very likely has not the knowledge that the practical side of the question gives by long experience.

Toronto, Jan. 25th, 1898. ED. PHILIP.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*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

### CHAP. V.

### ROADBED CONSTRUCTION.

### ARTICLE 27.—FOUNDATIONS.

The foundation of a structure is much more important than any other feature of its design, as on its security depends that of the structure itself. We may therefore be justified in examining closely into the bearing power of soils, the various methods of increasing it or distributing the load over greater areas, and the various methods of sinking or making foundations.

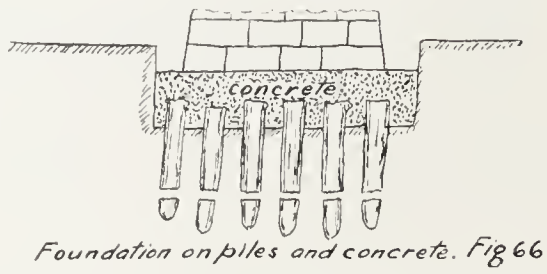
The bearing power of soils varies very much, being least for soft clays and unconfined quicksands, and increasing through sand, gravel, firm clay and hardpan to solid rock; it may be as low as one-half ton per square foot, and as high as 180 tons per square foot, but it is only with the lower values that we need deal. A good clay foundation will bear safely $2\frac{1}{2}$ to 4 tons per square foot, and dry sand or gravel from 5 to 6 tons, while cases have been known of 10 to 11 tons per square foot being carried. In railway work 3 or 4 tons per square foot is usually all that we want to put on to a foundation; consequently, whenever good firm clay (which will not be watersoaked), sand or gravel are reached, the foundation may be considered safe, provided we have sounded several feet, and in case of important structures, many feet below the foundation bed, to see that the substrata are equally firm. Rankine's earthwork formula takes account of the depth of the foundation beneath the ground level, and one rule in use in the Western States is that the safe load per square foot on sand is 2 tons + 1 ton for each 10 feet in depth. No account has been taken of the friction of the soil on the sides of the structure below ground level. This is only of importance where the foundations are sunk by pneumatic caisson or open dredging, in which case it is variously estimated at from 200 to 600 pounds per square foot of surface exposed to side friction. If the caisson is of cast iron, about 300 lbs. for wrought iron, 900 lbs. for masonry, 300 to 600 lbs. for timber, and for piles 500 to 1,000 lbs. per square foot.

#### FOUNDATIONS ON LAND.

Where a firm foundation is obtainable within a few feet of the surface, all that is necessary is to dig a pit below frost level, or to any required depth and commence stonework at once, or often lay 1 or 2 feet of concrete to get a uniform bed to lay on, if the foundation is bouldery or uneven; but if, on the other hand, the foundation bed shows soft spots or uneven bearing power, the difficulty may be overcome by using a deep bed of concrete which will span over small spots (provided there is no danger of undermining by scour from an adjacent river, liable to change its channel), or by using a grillage of timber instead, in cases where the timber will always remain watersoaked, but not otherwise. Again, the same expedients may answer if the whole foundation is somewhat, but not very, soft, by spreading out over a larger area. When, however, it is found that the foundation is too soft for such methods even if thoroughly drained, and that it will not pay to dig down far enough to reach a firm one, recourse must be had to some artificial method of obtaining greater bearing power, the usual way being to drive piles, although in some cases where cost is no object or the piles would be subject to decay, large platforms formed of cross-layers of steel I beams or rails bedded in concrete (as in Chicago), have been used to great advantage, the transverse strength being such as to enable a very much enlarged area being used. When sufficient piles are driven to carry the load required they may be cut off level and capped by drift-bolting on a double layer of 12 inch by 12-inch timbers, as a base for stonework, or preferably either on the broomed heads of the piles or after sawing them off, a layer of concrete is placed and also rammed around and between the piles, in which case the earth between the piles will take a portion of the load, being much compacted by the driving, indeed, in cases where timber is scarce, a method has been adopted of pulling out piles after driving and immediately filling the holes with well rammed sand, the compacted earth and the sand pillars together carrying the load safely. Cast iron and

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

wrought iron screw piles are used extensively in ocean jetty, lighthouse, and pier construction, but for foundations to masonry structures on land the wooden pile is in




Foundation on piles and concrete. Fig 66

almost exclusive use ; of the various ways of driving piles by steam hammer, drop hammer, water jet, gunpowder explosions or insistent weight, the first three are the only ones worth considering.

*The water jet* is used economically where water is plentiful, ordinary pile driving inconvenient, and in sandy, quicksandy or silty soils (indeed it is often the only means of driving piles in bad quicksands), the water is carried in a pipe down the side of the pile and is projected in large quantities and considerable pressure just below the point of the pile ; this allows the pile, assisted by a dead weight or by light blows from a small hammer, to sink very rapidly, the water rising in a film around the surface of the pile and almost eliminating friction as long as the action continues, but after driving is finished the sand or earth settles around the pile and gives as high a bearing power as with hammer-driven piles.*

*The Steam Hammer* weighs from 4,000 to 5,000 lbs. and sits on the head of the pile, striking a blow with a piston loaded with about 3,000 lbs., the stroke is $2\frac{1}{2}$ to 3 feet in length and about once per second. This keeps the soil and pile in a continual vibration and effects more than the occasional, though more severe blow of a drop hammer. Although a steam hammer is unable to drive in very hard ground economically, and is not economical where only a few piles are to be driven in a place, as the cost of transportation of hammer, boiler, steam-pipes, etc. is too great, yet wherever a great many piles are to be driven in one locality, as on docks, large foundations, etc., or where the outfit can be economically transported from place to place, it can drive piles much more cheaply and quickly than a drop hammer.

*The Drop Hammer* is raised either by hand, horse, or steam power, and usually a trip is arranged to free the hammer automatically at the top, the line being brought down again by hand, which takes time. In order to avoid this, sometimes, in driving by steam, the line is permanently attached, and a friction drum is utilized to let it drop without tripping, thereby dragging the line with it and lessening the force of the blow, but economizing time. The chief danger in this method lies in its abuse by dishonest contractors, where the pile-driving is specified for certain maximum penetration at the last blow, in which case, a slight friction on the drum will materially lessen the effect of the blow. The weight of drop hammers varies from 1,200 to 2,000 lbs., and the drop from 15 to 30 feet depending on the hardness of driving and pile head, and length of leads. The drop and steam hammer are in general use, and the load which a pile can safely carry may be approximately estimated by various empyrical formulæ, when the drop, weight of hammer, and penetration at the last blow (with an unbroomed head to the pile) are known, such formulæ are usually on the safe side, because although at least one instance has been given of a pile refusing to drive at all, and yet after a day's rest going five or six inches, yet the usual experience is that piles which will penetrate several inches at a blow, after long continued driving, will penetrate less, or almost refuse to drive after a rest of a day or two allowing the material to settle around the pile.

The three formulæ looked upon most favorably in America are :—

(*a*) Weisbach's or Sanders—

$$\text{Safe load} = L = f \times \frac{12\,WH}{S} \quad (f = \tfrac{1}{3} \text{ to } \tfrac{1}{8}).$$

(*b*) Trautwine's—

$$\text{Safe load} = L = f \times \frac{46\,W\sqrt[3]{H}}{S+1} \quad (f = \tfrac{1}{3} \text{ to } \tfrac{1}{12}).$$

(*c*) Wellington's—

$$\text{Safe load} = L = \frac{2\,WH}{S+1} \text{ (drop hammer).}$$

$$\text{Safe load} = L = \frac{2\,WH}{S+\frac{1}{10}} \text{ (steam hammer).}$$

($L$ = safe load in lbs. ; $W$ = weight of hammer in lbs. ; $H$ = drop of hammer in feet ; $f$ = factor of safety ; $S$ = penetration, per blow, in inches, for average of last four or five blows.)

Where penetrations are as much as two inches or over there is not much to choose between all these formulæ ; but for small penetrations the 1st one is evidently inapplicable, giving abnormally high results ; on the other hand, the third formula is conservative under all conditions, simple in use, and admits of a modification for steam hammer driving, in which *stiction** is not an element to be considered. It is also applicable down to zero penetrations for ordinary weight of hammer, drop and length of pile, as $L = 2\,WH$ is about what a pillar 12 or 15 inches in diameter and, say, 20 feet long will safely stand (taking $W$ = 2,000, $H$ = 25).

These formulæ neglect many small losses of energy in driving, and are, therefore, only empyrical ; but the results accord fairly well with the few facts known regarding the safe loads on piles. Evidently in ordinary soils, the skin friction is the important element in their sustaining power, as the load carried on the point of even a blunt ended pile would not be very great unless on solid rock.

Of the ordinary losses of energy in pile-driving, the only important one (neglecting the friction of the leads, the compressing of the pile, the bouncing of the hammer, which latter can be remedied by lessening the drop, or getting a heavier hammer), is the brooming of the head and point under hard driving. To prevent the former, a heavy iron band about three inches by one inch should be fitted around the head, and when brooming does occur, it should be sawed off at once. While in hard or bouldery ground the point should be shod with straps of iron and made rather blunt—in fact some drive with piles almost without a point, claiming that brooming is thus prevented—in quicksand, a pile turned butt downward will often be the only means of keeping it down during driving, and in all cases where piles are subject to severe vibration they will take a much less load than where it is a quiescent one. This is not included in the formulæ and must be provided for in the design.

For permanent piling in fresh water districts such woods as cedar, oak, yellow pine, rock elm, spruce and tamarac are in common use, being given somewhat in order of merit for durability, while any good wood may be used for temporary work. The cost for ordinary lengths will vary from five cents to eight cents per foot in favorable localities, to twelve cents or fifteen cents for oak piles at a greater distance, and even twenty-five cents or

*See *Engineering News*, Vol. 31, 1894, page 316, for jet pile driver.

* Stiction is that excess of frictional resistance offered, when a body is started from rest, over the continuous frictional resistance offered to a body while in motion, under the same conditions of surrounding material. C. B. S.

thirty cents per foot for the same in great lengths of fifty or sixty feet; driving will vary from two cents or three cents per foot in situations where great quantities are driven by steam hammer, to four cents or five cents per foot where driven by a track pile driver on cars; but for ordinary railway construction work, scattered and in small quantities, eight cents to twelve cents per foot is not out of the way. An ordinary price on railway construction is about thirty cents per foot for good piles, 12 inches in diameter at the small end, in place in the work, and fifteen cents per foot for all cut-off ends, this includes all labor of driving and cutting off to the exact height if on land, but cutting off under water is extra, and sometimes a matter of considerable expense.

*Deep Foundations on Land.* — Where foundations require to be carried down for any considerable depth, it is more economical to timber and sink vertically than to put earth slopes on the foundation pit, such timber will, in general, consist of vertical hand-driven sheet piles and horizontal rings of timbers and braces to sustain them at five or six foot intervals, as shown Fig. 67, Plate XIX.,

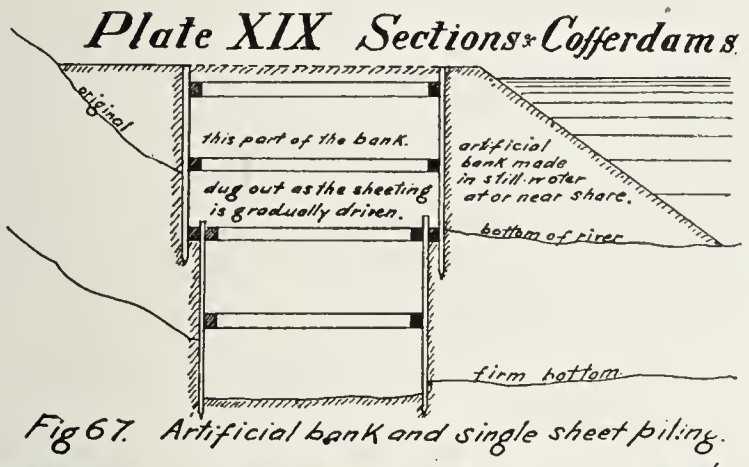


Plate XIX Sections of Cofferdams
original
this part of the bank.
dug out as the sheeting is gradually driven.
artificial bank made in still water at or near shore.
bottom of river
firm bottom

Fig 67. Artificial bank and single sheet piling.

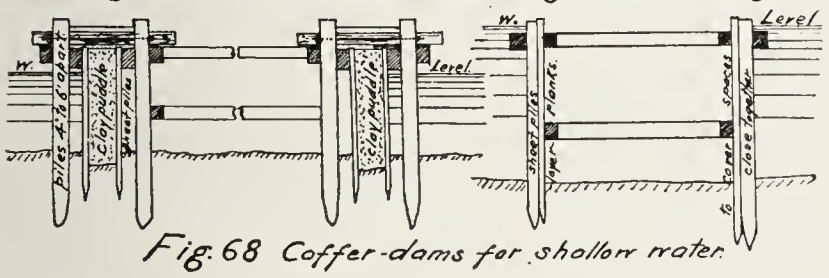



Fig. 68 Coffer-dams for shallow water.

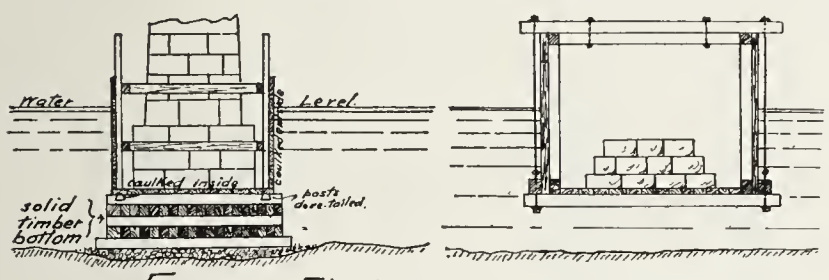



Fig 69. Floating Cofferdams on good bottoms.

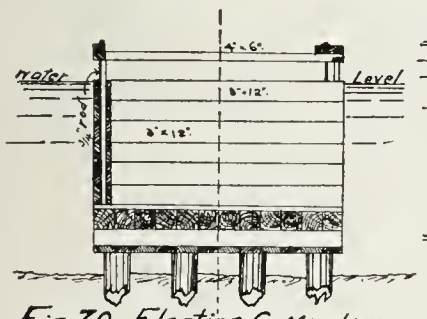



Fig. 70 Floating Cofferdam on piles

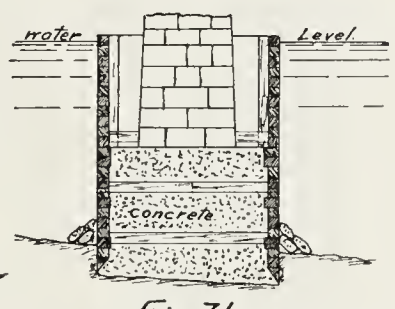



Fig. 71. Concrete-filled bottomless Caisson.

and in planning such work it is well to remember: (1) To allow for extra room more than is apparently required, in order to give freedom of movement, extra timbers, etc.; (2) To be sure to find out how deep it is to good bottom before digging is begun, in order to see whether piling might not be less expensive, and chiefly so as to be able to say definitely how many rings of timber there will be, and how much extra room will, therefore, be needed to step in all around about 15 inches every 10 or 12 feet in depth; this is a very important consideration. See Fig 67.

FOUNDATIONS IN WATER.

When masonry work is to be built in water, the considerations which determine the method to be adopted are: (1) The depth of water and its fluctuation in level. (2) The depth of soft material underlying the water which must be penetrated to secure good foundation. (3) The velocity of the current. (4) The money and materials available.

Of these considerations Nos. 1 and 2 are most important, and the total depth from water surface to bottom of structure will determine whether the foundation should be obtained by:

(*A*) Fixed cofferdams; (*B*), floating cofferdams, with solid timber bottoms; (*C*), bottomless cofferdams or caissons; (*D*), compressed air; (*E*), open dredging.

*Fixed Cofferdams.*—These are used where there is shallow water, at most only a moderate current, and where the bottom is of such a nature as to admit of sheet piles being driven in and the foundation suitably excavated to a firm foundation bed. This may be accomplished in various ways. Where the structure is near shore and waste excavation is available, it will pay to make an embankment above water level, and carry down hand-driven sheet piles kept in position by rings of timber, the excavation being always kept about level with the bottom of the sheet piles. This method is illustrated in Fig. 67. If, however, the structure is not thus situated, the sheet piles are either driven in a double layer, as in Fig. 68, or a single row of Wakefield sheet piling is used (this is an artificially made sheet pile composed of three planks spiked together to form a tongue and groove). If any of these methods are employed, a centrifugal pump will be kept busy keeping down the water while the foundation courses are being laid, but in case such pumping power is not advisable or available a more expensive form of cofferdam can be used, as in Fig. 68. Rows of guide piles are driven at considerable distances apart, then walings are bolted on, and a double row of sheet piles is driven around the area to be unwatered, between which is rammed clay puddle, making a very watertight, but expensive, cofferdam. This is generally employed in extensive works where the area is to be unwatered for some length of time.

*Floating Cofferdams with Solid Timber Bottoms* — It is moderately certain that as long as timber is covered with running fresh water it will never decay, and it is even contended that in any fresh water it is practically safe also; this has led to the adoption of methods of foundation building which do not involve the unwatering of the bottom. If the bottom is bare and moderately level, or can be dredged to a good bottom and levelled up with broken stone, it is manifestly easy to build a watertight box with either a solid timber (Fig. 69) or stone-filled crib, or only a plank layer, as a bottom (Fig. 69), and, after floating it into position, sink it, by building in it or by external loading, and after the structure has been built up above water level tear off the sides of the watertight box, leaving the bottom as a permanent part of the structure. If, on the other hand, the foundation is soft and good bottom can be reached by piling, the piles are driven to a firm bearing, sawed off under water close to the bed of the river, and the same operation as just described is gone through, the structure being landed on top of the piles as a foundation, as in Fig. 70. These methods are cheap and satisfactory in situations where the current is not excessive, but in very swift currents such constructions are not as manageable as the bottomless cofferdams to be described, and even where used, it is

found advisable to build the timber work and footing courses of masonry considerably (1 to 2 feet) larger than the neat work, which is laid out after the crib is in its final position. This provides for some permissible inaccuracy in sinking. The cribs are well drift-bolted together and the boxes caulked with oakum and dove-tailed or bolted down to the bottom, so as to prevent them lifting when the sinking process is going on.

*Bottomless Caissons or Cofferdams.*—Where no timber is desired under the masonry, or where the current is very swift, the method shown in Fig. 71 has been found best, but is only admissible where good foundations are easily obtainable. The bottomless box is floated into place, loaded until it sinks to the bottom, and then is either unwatered by having a large canvas flap around the outside of the bottom, held down by bags of concrete, thus nearly sealing the bottom, the caisson being then pumped out and the bottom excavated or levelled off with concrete, or else, if the bottom is already firm, as is usually the case in swift currents, there is no necessity for unwatering until a great depth of concrete has been put in, forming a watertight bottom ; in the latter case, if there is an irregular rock bottom, the caisson cannot be made to fit it, and in order to keep the undertow from carrying away the concrete as fast as deposited, or even dissolving out the cement, it is found necessary to fasten a canvas flap around the inside of the bottom and load it down with bags of concrete, pea straw, etc., until a bottom has been formed And in depositing the concrete it is done by lowering an iron box, with a hinged bottom, containing about one cubic yard down to the bottom ; the box is tripped, allowing the concrete to slide gently out, whereas it would become dissolved if allowed to fall any distance through water. After such a bed of concrete has been formed as is considered sufficient, the caisson may be pumped out and construction continued in open air.

*Compressed Air.*—Where a great depth of water and soft foundations are encountered the methods previously described must be abandoned. Early in this century the vacuum air process was tried, by which the excess of outside pressure forced soft materials up inside a vacuum chamber, this material being excavated, air was again extracted, and each time the hollow chamber of wood or iron sank down by its own or added weight ; but this method was found uncertain in its means of directing the sinking, was capable of only limited application and failed entirely on encountering stiff clay or boulders, besides it did not enable the bottom to be personally examined and properly prepared for the foundation layers.

Very soon the plenum or compressed air process was tried, and to-day it is recognized as being in every way most satisfactory until greater depths than about 100 feet below water level are to be obtained, when open dredging through wells must be resorted to. Figs. 72, 73 and 74 show common forms of the same process. The drawings are almost .self-explanatory, the pressure of air in the working chamber is constantly maintained, and the extent of the pressure must always be sufficient to keep out water ; the tendency being for compressed air to be continually escaping around the working edges, and bubbling up to the surface outside the chamber. Where pneumatic cylinders are used, they are in pairs, sometimes braced together, the two supporting one end of a truss, and being completely filled with concrete after bottom is reached. See Plate XVI. One larger cylinder, as in the Hawkesbury bridge, with elliptical ends will, however, be much more stable.

Where large timber working chambers are used they must be very strong, as the whole weight of the pier will be carried on their backs until the working chamber is filled in, which is not until firm bottom is reached. It may be shod with iron or merely with timber, depending on the materials to be met with, and on top of this chamber may first be constructed a timber crib as in Fig. 74, extending up to the ground surface and filled with alternate pockets of concrete or broken stone sufficient to sink the chamber, which crib is built up gradually as the process goes on. Or, if advisable, the masonry may be commenced immediately on top of the working chamber as in Fig. 73, this will usually be done where the foundation is not a very deep one. The support which a deep caisson sunk by this method, or by open dredging gives to a pier and bridge, is partly by the bearing on the bottom and partly by friction on the sides, which is estimated at from 300 to 600 lbs. per square foot of surface, and is an enormous item in such a structure as that of Fig. 74, amounting to 2,000 or 3,000 tons. Of course, this resistance is not all to be overcome while sinking, for the continual movement and escape of a film of compressed air tends to aid sinking by lessening friction.

The material to be excavated is forced out of the discharge pipes by the compressed air, if it is finely divisible, by opening valves at the mouths of flexible pipes, but boulders, gravel, logs, etc., must be laboriously taken out of the air lock in small quantities, making the operation costly. The air shaft and lock form the means of ingress and egress, and it is a question whether it is safer and

*Plate XX*

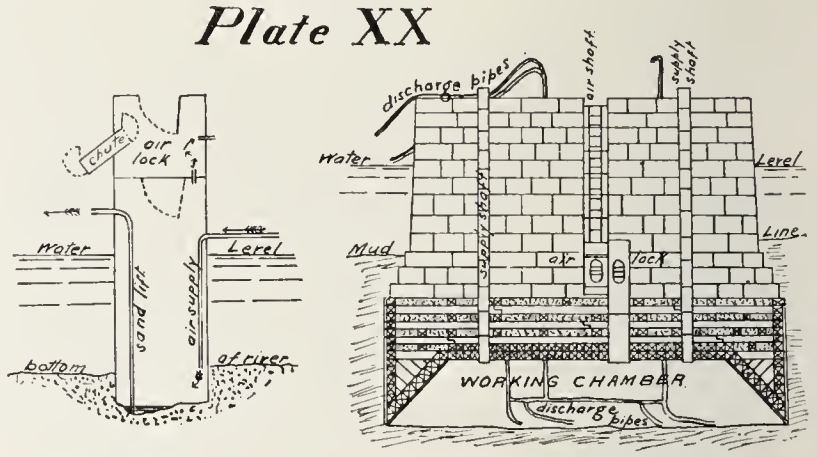



Fig 72 Pneumatic Pile. Fig. 73 Pneumatic Caisson.

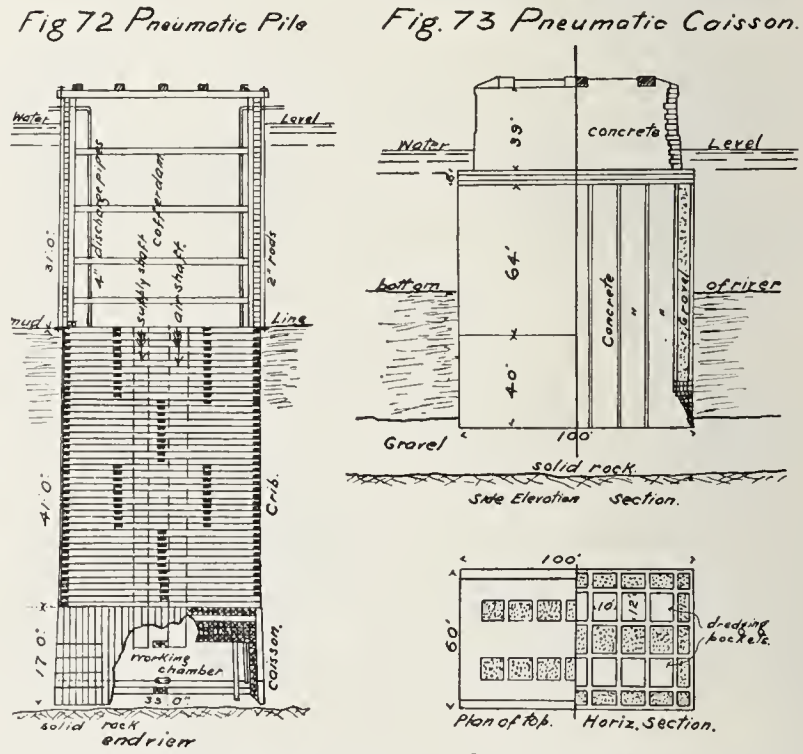



Fig. 74 Pneumatic Caisson with Crib and Cofferdam. Fig 75 Open Dredging Caisson ⅓ Pier.

more convenient to have the air lock near the top or bottom of the shaft, the former, however, being safer for the men. The process of working the lock is to open one door, pass in, close the door, open a valve so as to raise or lower the pressure as the case may be, and then open the other door and pass on, some time being necessary to prevent injury to the lungs and ear drums ; men can work in about

4 atmospheres pressure as a safe maximum, and then only for three or four hours for healthy men; with less pressure the period of labor may be lengthened, but on coming out to the open air the depressing effect of a lowered pressure must be counteracted by a strong stimulant like coffee, to prevent injurious consequences; and for reasons of safety the compressed air is taken from a receiver and not direct from the compressor. So that an accident to the machinery might not have an immediately disastrous effect by permitting an inrush of water before the men could escape.

The supply shafts marked are only used at the last, where concrete is passed in through them, to fill up the working chamber. The shafts themselves are also all filled with concrete, and the whole structure is a solid mass of timber, concrete and stone. Sinking foundations by compressed air has many advantages—the sinking can usually be quite accurately directed; it enables all the pier construction and excavation to proceed together; it enables all kinds of materials to be removed, and it permits of a careful examination and preparation of the bottom before concrete is put into place.

An example of such construction is detailed in Patton's "Foundations," at a cost of

$16.82 per cubic yard for the caisson material;
$10.76 " " crib "
$7.83 " " sinking "

making an average of about $20 per cubic yard. This was for a depth of 68 feet below water and in 56 feet of mud – evidently the cost would vary with the depth and the materials encountered, in this case the sinking was at the rate of 1½ to 2 vertical feet per day.

*Open Dredging.*—This method has been long practiced in India, where circular brick wells are built with heavy walls, and gradually lowered through soft soils by excavating and undermining, the material being raised in some primitive manner. This is improved upon now by using steel cylinders and excavating by clam-shell or other dredges. There is usually difficulty in controlling the direction of movement, and large logs and boulders are troublesome. So that open dredging is usually used only where the depth is too great to admit of using compressed air and where the materials can be freely dredged (in India, submarine blasting of boulders, etc., tended to crack the cast iron cylinders, but would, probably, not have a bad effect on timber cribs). A striking example of this process is that of the foundations for the Poughkeepsie bridge, which were sunk through a depth of 50 to 60 feet of water and 75 to 80 feet of mud, clay, sand and gravel, or a total distance of 140 feet below high water. (See Fig. 75.) The cribs, 100 feet by 60 feet, had 31 gravel pockets, extending from top to bottom, which afforded enough load to sink the cribs when undermined; there were 14 dredging wells extending from top to bottom 10 feet by 12 feet, in cross section, through which the dredging was done by a clam-shell dredge. The walls were 2 feet thick of solid timbers, laid in alternate lapping courses, well drift-bolted together, and after the cribs arrived at good bottom the wells and pockets were filled with concrete, and a floating caisson similar to Fig. 69 was brought out into position and built into until it sank on to the top of the crib. The chief difficulties in carrying out this process, aside from anchoring such a huge mass of timber in a swift current, preparatory to dredging, are that it is difficult to guide the crib in direction as it settles down, and that logs, boulders, etc., under the cutting edges, cause delay and necessitate, often, sending down divers. A combination of compressed air and open dredging has been used in Europe, in which several working chambers surround an open well, the men force the material out under the inner edges of the working chambers from which it is removed by a clam-shell dredge; the process is cheaper in handling the material, but uses an enormous quantity of compressed air.

(*To be continued.*)

*For* THE CANADIAN ENGINEER.

## DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON.

(*Concluded from last issue.*)

Lately the scientific journals of the United States have been reporting a process of garbage disposal invented by a person named Harris. I visited his experimenting room and examined the garbage gas manufacturing machine, consisting of an extra large wood burning box stove, covered by two iron tubes, which acted as retorts for carbonizing the garbage, with another tube on top of the two, which answered for a superheater or reburner of the gas after leaving the retorts. I saw four lights of gas burning, stated to be from the gas manufactured from the garbage in the retorts, but after reading the description published on page 170 of the October issue of THE CANADIAN ENGINEER, I feel almost certain that the gas I saw burning was made from the coal oil, and, probably, chemicals that were mixed with the garbage when charging the retorts. I do not believe that Mr. Harris has found a chemical that can work what should be called a miracle, supposing that the reports should be true. A fuel gas can be made from vegetable or woody garbage that would add a great quantity of heat to a fire composed of wood or coal fuel, but would make a poor show if depended on to give heat or light alone. But even this kind of gas can scarcely be made with the little heat that can be generated with the experimental box stove, and I base my opinions on a two years' experience in the manufacturing of illuminating gas from sawdust, and the lessons I received, teaching me how to make water gas, and when I have explained the two methods, my readers will be able to judge the soundness of my views.

If ten pounds of melon skins and potato peelings be properly dried until all the moisture is extracted, it will be found that the vegetable substance left will weigh under 3½ pounds, proving that there was 6½ pounds of water in them, so that there is 3½ pounds of vegetable that can be made into fuel gas by a heat at a temperature of about 2,000° F., and 6½ pounds of water that can be made into a good heating gas, by first converting the moisture or water into a high pressure steam, then passing the steam through red-hot pipes which super-heats it, making the steam gaseous, then discharging it on to a fire heated to a temperature of about 3,000° F., in fine small jets, it is then turned into large volumes of gas, and by allowing drops of coal oil to drop on to the fierce fire along with the fine sprays of gaseous superheated high pressure steam, a passable illuminating gas is made at about the third of the price Harris declares he can make gas from garbage. In making gas from sawdust, we carbonized sawdust that was first dried well upon hot plates; if we needed illuminating gas we carbonized pine wood sawdust containing plenty of resin, which was probably the substance that gave out most of the gas needed. If we were well stocked with gas, we then carbonized dried hardwood sawdust that made large quantities of valuable acids; but we could not use wet sawdust to advantage, no more can Mr. Harris use wet garbage to make gas, for the two materials have a similarity. If we used sawdust in an undried state it condensed watery acids and threw off a

gas, useful only to burn under the cast iron retorts along with the bunch wood. So, plainly speaking, Mr Harris cannot make a combined vegetable and water gas with the heat that can be got out of wood burning box stove, because the heat needed to make gas from watery vapors would melt both his stove and his iron retorts, and the gas got from vegetable refuses will not be profitable to manufacture into illuminating gas.

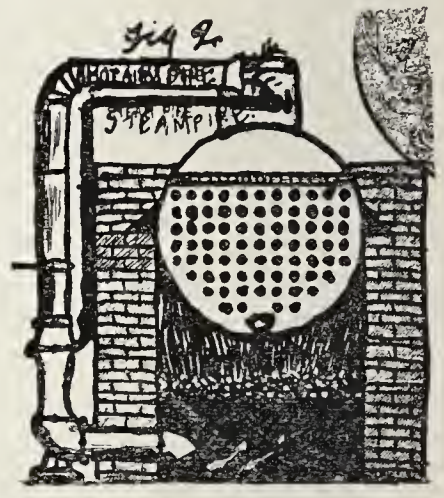
The scientific papers of Great Britain make fun of the reports published in the United States about the garbage gas invention, and laugh the project out of court, saying that the reports read like fairy tales. There is a sarcastic article on page 522 of the *Surveyor*, printed in London, Eng., Nov. 5th, that handles Mr. Harris' reports of his invention without gloves.

It is in order for the inventor to prove that he has found a chemical that will totally change vegetable substances and give them a virtue equal to coal that has taken the earth thousands of years to instill into its nature the gas and heat-giving properties. When that can be done I will gladly welcome the invention.

In Bradford they destroy bad meat and fish by a machine similar to a boiler, that possesses a steam jacket, and revolves, and is evidently filled with knives, for after the wet meat has been in and revolved about an hour, it runs out through a small hole in a fine dry powder, of great value for fertilizing, and the residue of the furnaces is manufactured into mortar, etc. They also find a paying market for every castaway found in and picked out of the rubbish. With the heat evolved they generate electricity and supply power for useful purposes. At Southampton they have lately set in a few extra furnaces of the Goddard, Massey & Warner's type, with forced draught appliances, making them capable of burning 15 tons a day. Multitubular steam boilers are erected on the top of these furnaces that generate steam to a pressure of 160 lbs, which is used to pump and turn the machinery that chemically treats the sewage of the town. The boiler being placed on top of the furnaces will cause the hot gases to have a continuous rising grade from the furnace to the chimney, while in other destructors the gases drop down several feet from the combustion chambers to the underground flue, often as much as 15 feet. This system will be highly satisfactory to engineers, who believe that bending and dropping the flues, and compelling the smoke and heat to go down hill, spoils the draught and wastes the heat. The destructors at Rochdale are somewhat different to the others, being fired by hand through the clinkering doors at the front, similar to the Lancashire boiler. This has the advantage of its being possible to spread the refuse evenly over the fire and of the proper thickness to insure quick combustion, destroying a larger quantity of refuse than those that are fed from the top, but, on the other hand, the objectionable stuff has to be tipped on the ground floor in front of the furnaces, in place of on top out of sight of most of the attendants, and where the smell can be least perceived. The boroughs of Dewsbury and Warrington have the high temperature destructor furnaces designed by Beaman & Deas, which supply the largest number of units of heat, and a small residuum of well-burnt clinker and ash. They create a great heat from the foulest refuse and garbage that can be handled, supplying a greater amount of heat per lb. of rubbish consumed, besides completely destroying the poisonous fumes usually thrown off when burning excrement, offal, etc.

These furnaces are built in pairs, the fire bars being horizontal, at the rear end there is a sloping, inclined, drying hearth and it has the feeding door at the back end, where the refuse is usually thrown in by hand labor, and when the fires are cleaned and clinkered at the front doors, the refuse which has dried with the heat from the furnace during the time it has been lying on the drying hearth slides down on the top of the fire. There is only one combustion chamber to each pair of fires. Each fire is fed and cleaned alternately, so that when one fire is newly charged with green refuse, and consequently at its coolest period the twin fire is at its highest temperature, and both having to deliver their discharged smoke and gases into one and the same combustion chamber, the high temperature of the one mixing with the low temperature gases of the other, reburns it and raises it up to a high temperature. Thus, the combustion chamber remains at a white heat, which fully destroys any unconsumed fumes of foul gas that may be cast off by the furnaces. A suitable fan is used to create a forced draught which delivers the current of air into the closed ashpit, thus the air is forced pretty evenly between the grate bars into the body of the fire. The crown of

FIG. 1.




the arch over the fire, called the fire screen, being the partition between the furnace and combustion chamber, is perforated with holes near the front, over the cleaning door, for the escape of the smoke and gases, which compels the fumes from the roasting refuses on the drying hearth to pass over the fire from back to front before entering the combustion chamber. Perhaps the most advantageous and valuable feature of this destructor is the hollow firebrick fire-bridge that forms a passage of atmosphere air from the outside to the rear end of the combustion chamber, where it enters through a quantity of small distributing holes, adding a quantity of warm air to the fiery gases entering the chamber, supplying them with the oxygen needed at that point to reburn and increase the temperature of the gases sufficiently to thoroughly burn and purify the obnoxious fumes. It will be obvious that the cold air passing through the fire bridge must pick up a large quantity of heat by radiation and enter the combustion chamber at a moderate temperature. It is stated that the clinker comes as low as 25 per cent. of the weight of refuses destroyed, while the slow combustion only reaches 33 per cent., a difference of 8 per cent., which means a great deal in the cost of cartage where the residuum of the furnaces has no handy way of being disposed of or manufactured into mortar slabs, paving brick, etc., etc.

This type of destructor has been improved upon in several ways, viz.: In place of using a cold air fan, which chills the fire at the point of attack, cooling the clinkers and causing them to stick to the grate bars, a combined steam and warm air blower is used similar to the steam blower mounted by R. S. Earl, of Toronto, over ten years since, and employed by many steam users in Canada and United States. It consists of a bunch of fine steam jets discharged into about a 9-inch tube, something similar to

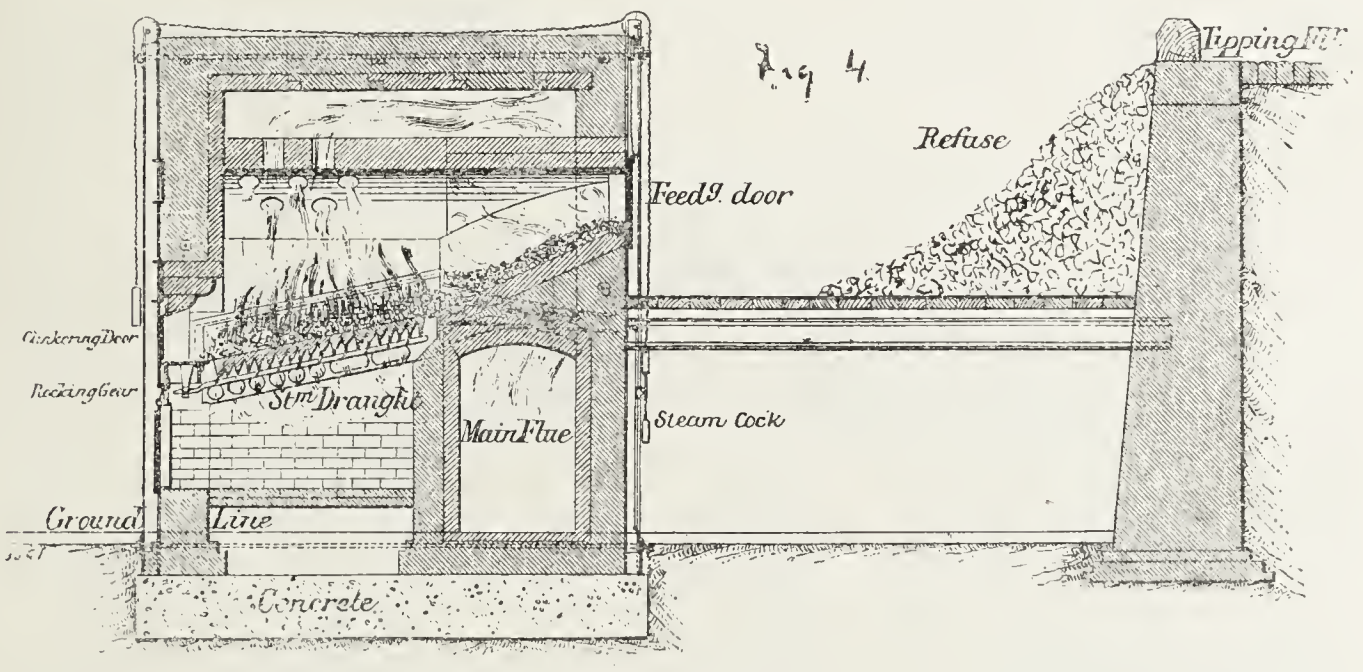
Fig. 1 and Fig. 2, which shows the blower in the act of giving a forced draught to a steam raising boiler. This will help to explain how the machine acts in this kind of a destruction furnace. It shows that the supply of air in that case is drawn by the exhausted steam jets from over the heated boiler, and mixing with the hot steam in the ashpit, where it enters the furnace between the bars at a high temperature, without the least shock or cooling effect to the outer edge of the body of the fire. When applied to a destructor furnace the air and steam is superheated on their way to the ashpit from the blower, by passing through the hollow, square cast iron tubes that form the side walls of each furnace (see Fig. 3 and 4.) The steam blower is fixed in position at the side of the inclined drying hearth (see Fig. 4), and at the point where it enters the hollow walls. Arrangements are made to draw off the fumes discharged by the roasting refuse, forcing them into the ashpit to be passed through the body of the fire, which thoroughly cremates them. It will be seen by the sketch that the blower exhausts the foul air both from the tipping floor, where the men stand to charge the furnaces, and the drying hearth behind the fire, thus making the handling of unhealthy and disagreeable excrement or offal almost as healthy as ploughing a field, besides giving a strong forced draught to the fire, saving the expense and doing double the work of a tall chimney. The firebrick sides of furnaces are usually the place where repairs are oftenest made, and it is an improvement to have hollow iron boxes, because they form a passage for the steam and air, which prevents them from ever getting red hot and burning out, as all firebricks appear to do at this point, therefore besides being of material use, they also save expense and annoying stoppages, but on the other hand they will have an acute chilling effect on the fire, which is made up again, by extra efficiency and power of the steam draught, and the extra units of heat made from the chemical combination

FIG. 2.

of the steam and the burning material. At Oldham, Hamburg and other places these improvements are in full working order. They are patented and controlled by the Horsfall syndicate, even to the rocking bars and steam blower, which are purely American. The cost of construction and full equipment is about $500 for each cell or furnace, when the number of furnaces built exceeds four in a block.

It will be noticed that the Beamans and Deas plan of building the furnaces in pairs, each joining with one combustion chamber, and the introduction of oxygen into the combustion chamber, are advantages that go far to counterbalance the improvements controlled by the Horsfall syndicate. In other points they are similar in build, and if the good points of each could be combined, a unique and powerful destructor would be produced. In European towns that have a close packed and dense population they have as many as thirty furnaces grouped together in a circle or other convenient design, having a large secondary combustion chamber or vault that receives the flues from all the first and separate combustion chambers; the walls of this vault get red hot and assist in again mixing and reburning the gases, thus for a second time increasing the temperature and purifying the gases cast off by the refuse and offal of each furnace. The annexed illustration (Fig. 4) shows a sectional elevation through a Horsfall furnace with the latest improvement attached; Fig. 5 shows the position of the ten furnaces in the small town of Oldham, England. The chain governing the steam valves that cut off the steam from the blowers when the man desires to open the front doors is shown passing over the head of the furnace and hanging down to a convenient point. The fire screen, the combustion chamber, the drying hearth, the rocking fire bars, and the route that the smoke and gases are compelled to take are all clearly shown to the point where they enter the flues on their way to the general collecting vault, from which they are conveyed to the boilers which generate steam, that creates power to run any kind of machinery necessary to do the power business of the town, and the temperature of over 2,000 deg. Fahr. is reduced to about 600 before it enters the chimney, which may discharge the purified gases close to the windows of a closely built district, without the slightest injury to health or contamination of the atmosphere.

We are told by parties that have visited and investigated the details of construction of every kind of destructors at present working in Great Britain, that the managers, the inventors and attendants of each kind assure the visitors that their system is by far the best, and point out the advantages, showing high-class testimonials,

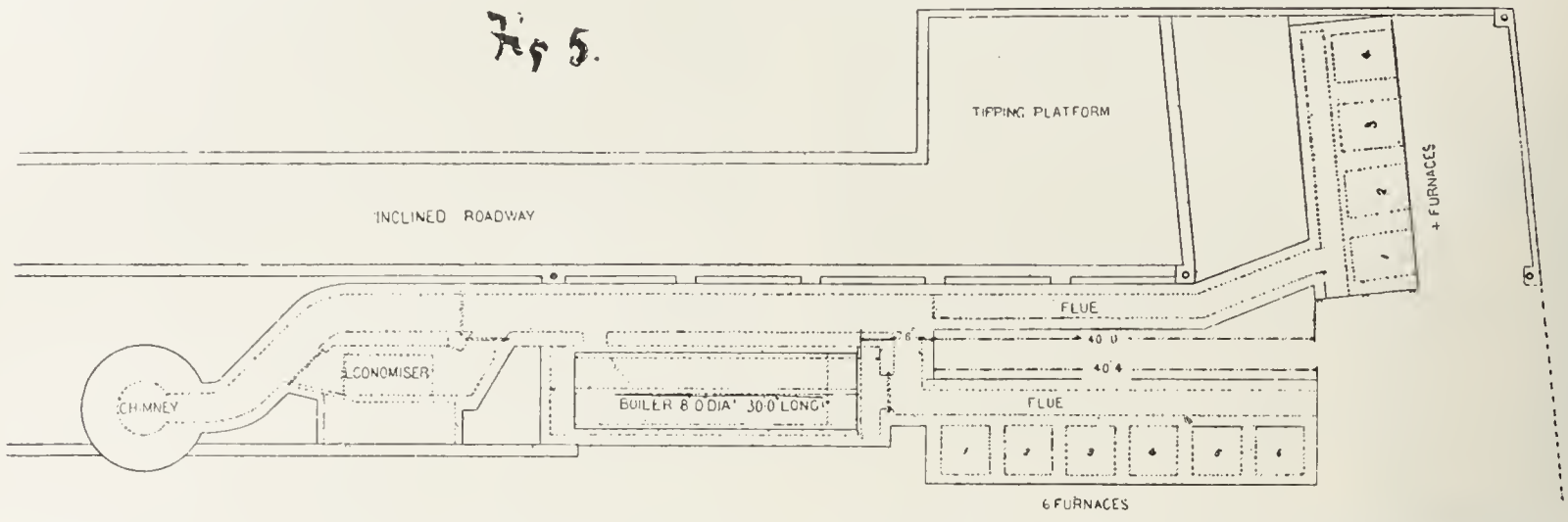


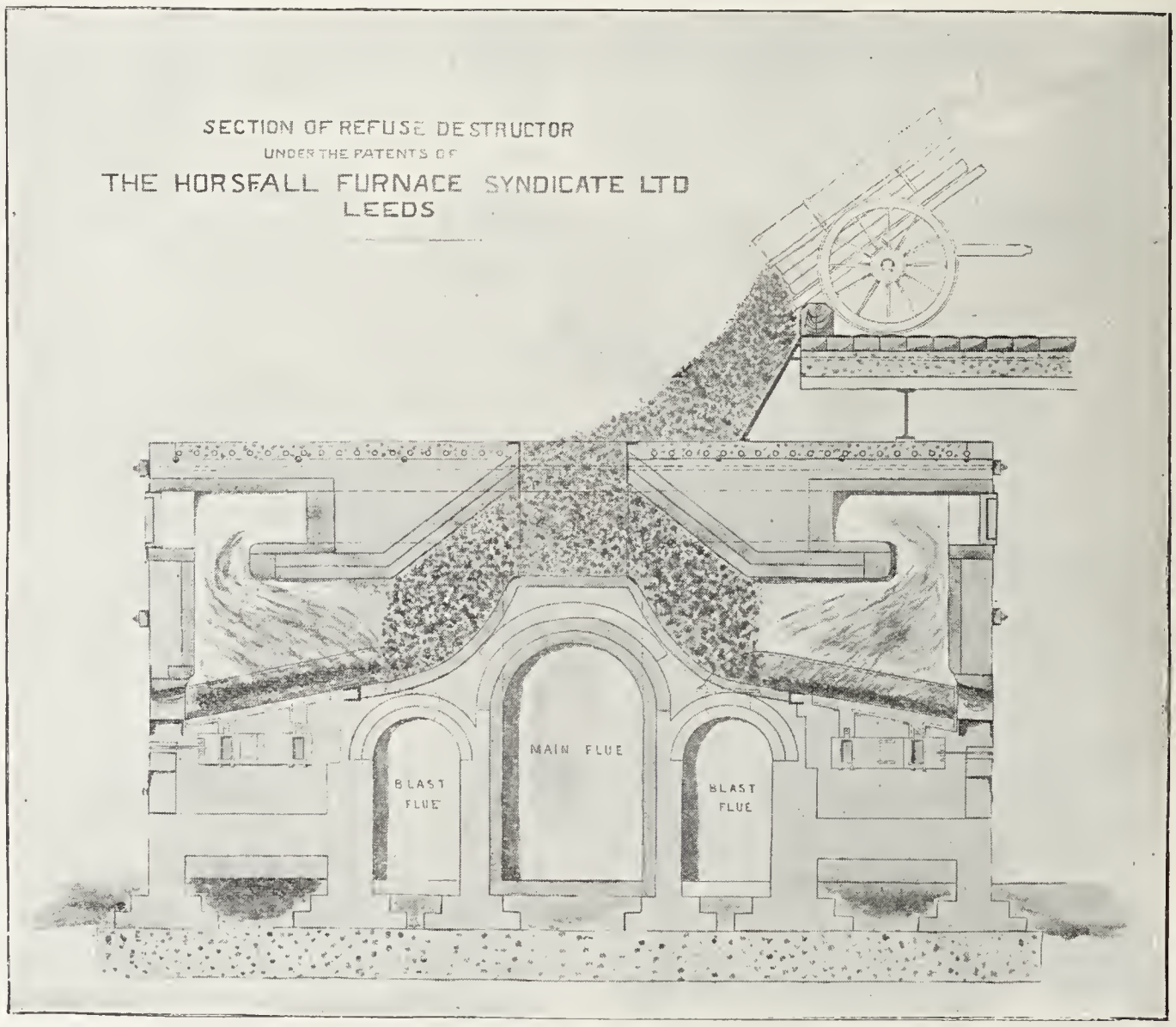

besides many pages of praise written in their book by previous visitors, which goes a long way towards mystifying and misleading deputations seeking knowledge. Those using the slow combustion and low temperature class, point out that one man can attend to fifty per cent. more fires than the men who attend the high temperature furnace, which may be true, but it is also true that the man attending to two high temperature furnaces consumes thirty tons of refuse each day, while the man who attends three low temperature fires, or one more than the other man, only

destroys twenty-one tons, or nine tons less than the man that only attends to two high temperature forced draught fires, so that their plausible argument is ridiculous when worked out in figures. They have a more combative objection, they say that the high temperature furnaces will soon burn out and the repairs will come high and expensive. Past experience of the few years that high temperature furnaces have been in use continually does not bear out the statement, for they remain sound and whole in places where they were well and properly erected, proving this argument wrong. The slag that attacks the brick in high temperature furnaces, and often believed to be caused by melting and running of the fire-brick, appears to have been proved by experts and experiments, together with careful watching during the past three years, to be silicious particles produced by the burning refuse and forced by the blast against the brick work, and can be easily knocked off. They also assert that it protects rather than damages the walls; this information is very satisfactory, and it is to be hoped that some person will find out a way of reducing silicious matter to either a powder or a gas, so that it will cease to be troublesome because it is a non-conductor of heat, and any combustion chamber lined with stalactytic formation will be useless as a re-burner of fumes and gases.

The solid advantages of high temperature furnaces is, that they burn all the fumes and injurious gases, without the aid of an expensive fuel eating cremator; they extract more heat, they reduce the refuses to the smallest possible weight and bulk, they make a harder and better clinker, they extract more heat per lb. of refuse and do double the work of the slow combustion type with less labor. Most of the low temperature sort are being altered and a forced draught added, making them into high temperature destructors, some of them on account of complaints that the unburnt fumes being discharged from their chimneys are a public nuisance. Before closing the subject of refuse disposal of towns, I might describe a useful refuse or house garbage destroyer, that if well built and carefully attended to when in use will be useful and valuable to any high-class residence or public building, placed in a country position where they cannot have the comforts of modern sanitary appliances, except they construct private ones for themselves. And where such places have their own private drainage and sewage disposal works this simple garbage destructor machine seems necessary to prevent the grosser solids, paper, grease, etc., from passing forward to the sewage settling tanks and choking the valves and pipes. The illustrations here produced, together with the explanatory references, will go a long way to

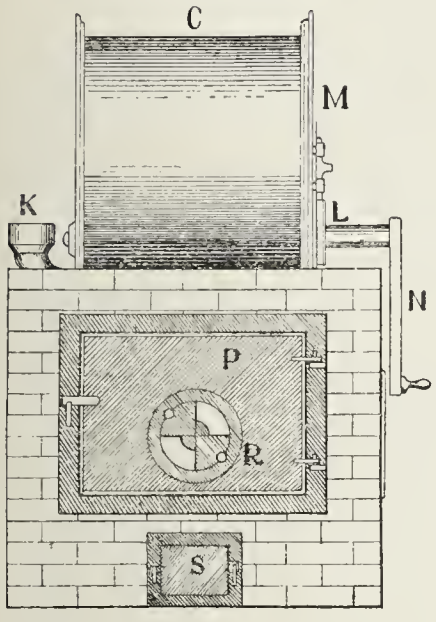
Fig 5.



explain the working of the machine. The apparatus consists of a series of perforated swinging buckets, holding about 1½ cubic feet, hung on a cross-bar, which holds in position the arms radiating from a central shaft similar to the Ferris Wheel. They are enclosed in an air-tight case, which has a connection by an iron pipe to a chimney and a 4-inch iron soil pipe that bring all the excrements and

Fig. 7



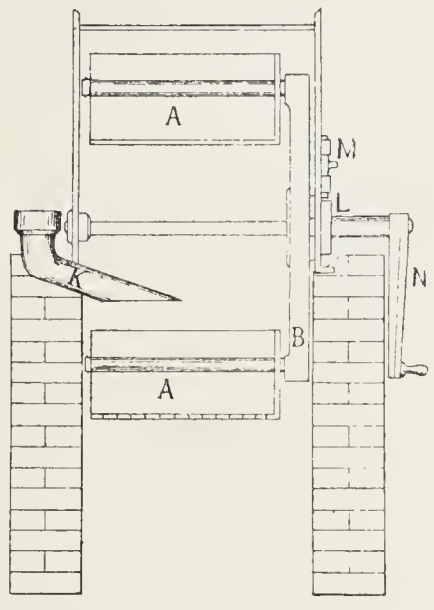




Fig. 8

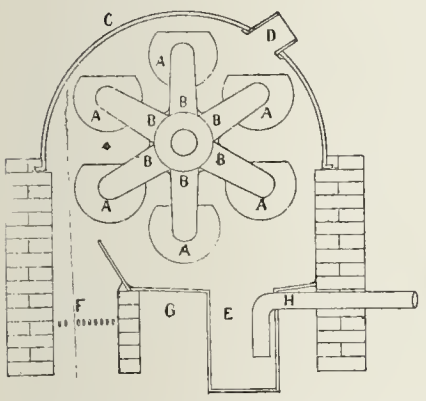
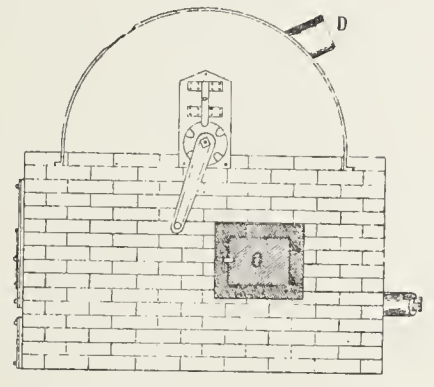



Fig. 9.




*A A A* are the buckets or baskets of about 1½ cubic feet capacity *B B B* are the arms supporting buckets. *C* is the casing resting on an 8-inch wall *D* is the opening and thimble to connect to chimney. *E* is a grease trap made of common tiling. *F* is the grates. *G* is sand or clay filling. *H* is sewer pipe. *K* is cast iron intake pipe, *L* is ratchet wheel. *M* is the pawl to engage with ratchet to hold buckets in place. *N* is the crank arm. *O* is a door to get to grease trap. *P* is large door for access to buckets. *R* is a damper to regulate drafts. *S* is the ash-pot door.

sewage made in the building to the swinging buckets, together with the house garbage (except coal and wood ashes), which all fall and enter into the lowest bucket. The lowest bucket is securely held under the soil pipe, and when one is filled with the grosser solids, the attendant turns the wheel a notch, raising the full bucket up out of the way and leaving an empty one under the soil pipe. By the time the sixth bucket gets full the first is dried by the current of air circulating through the machine by way of the fire bars and chimney. The machine is so constructed that the sludge cake is easily turned out into the fireplace and the bucket swings back into its place. When the furnace place gets full with dry cakes, they are set on fire and quickly burn by themselves, and at the same time dry the contents of the six swinging buckets. If this cremator could be fixed near but outside of private buildings, it would answer for isolated places. There will be some smell from the machine, and the fumes from the burning sludge will pass out from the chimney when the sludge cakes are burnt about once a week, but the contrivance seems the best in sight yet for country places, and a great improvement on the present system in use.

A large number of towns dispose of their rubbish by sorting and cleaning that part of the rubbish that cannot be made into a manure, using the carbon and inflammable material for generating steam, and to enable the sorting to be done in a healthy atmosphere and without soiling the dresses of the employees, the best and latest designed machinery is used. By so doing, the cost of collecting the refuse is about covered by the sale of the products. Most of the cities and towns adopting this plan also adopt the pail system of privies, in place of vault privies, and very few water-closets are in use, because, having a well-disciplined army to regularly go around once a week or oftener to remove the full one, clean the place of lodgment out, and replace a well cleaned, disinfected pail, the places are kept sweeter and healthier than 90 per cent. of the water closets in use, and the sewage of the town is easier handled, being almost void of excrements. There are also towns which have the dual system of manufacturing manure and selecting out salable castaways, also destructor furnaces to consume the most objectionable offal that is collected.

Whatever system is adopted, the success and healthful efficiency almost entirely depends on cleanliness and well-disciplined management.

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*For* THE CANADIAN ENGINEER.

## WATER MAIN CLEANING IN ST. JOHN, N.B.

BY W. MURDOCH, C.E.

There are three leading mains supplying the city of St. John, N.B. Number one, 12 inches in diameter, was laid in the year 1851; number two was laid in 1857, and has a diameter of 24 inches; number three also twenty-four inches diameter, was laid in the year 1873. The reservoir from which the city's supply is derived is an artificial lake on Little River, distant five miles from the summit of the city and 160 feet above the level of high water in the harbor. The summit of the city is 130 feet above h.-w. datum, and the hydraulic gradient in summer time generally reaches this district at an elevation of about 145 feet, the fall being thus about 15 feet, and the head of water 15 feet. In winter this head of 15 feet has been known to disappear during lengthy periods of zero weather when water was being wasted to prevent freezing.

The two older mains had become so foul through internal incrustation that, when No. 3 was shut off for repairs and the city depended on the other two pipes, all the portions at a height of 80 feet or more above datum, comprising an area of about 200 acres and containing a population of about 8,500 souls, were without water. On the other hand, with No. 2 shut off and supply coming by Nos. 1 and 3, every pipe was full and water delivered at a level of 130 feet. This was an ample demonstration of the foulness of the old mains as compared with that last laid. In the summer of 1897 the common council passed an order directing that the mains be cleaned, and preparations were forthwith begun.

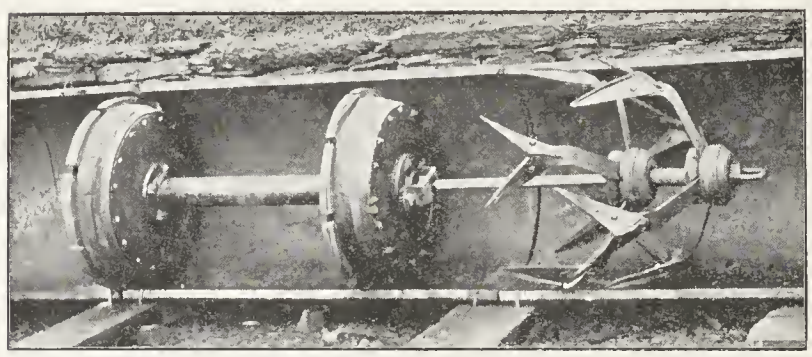
There being no hatch boxes on the main lines, such fittings had to be designed and tenders asked for their manufacture. James Fleming being the lowest bidder, he was awarded the contract at two cents per pound. Delivery began in the month of October, and the work of cleaning No. 2 was started soon after. In designing the cleaner or mechanical scraper, special precautions were taken to avoid the misfortune of having it lodge in the pipe with such consequent vexations, searchings and cuttings of pipe as have often occurred elsewhere. The desiderata laid down were:

*a*. That the apparatus be as light as possible, so as to

be easily projected up ascending gradients by the pressure of the water, and to offer generally as little resistance as possible whether through inertia or otherwise.

*b*. That as it is more desirable to take light cuts and make frequent runs, than attempt to remove all the dirt at once and have the scraper stick; therefore, the pistons should be so loose as to permit a free escape of water to carry off the loosened dirt in advance of the cleaner, and that the arms be not so rigid as to hold it up against any hard and abrupt obstruction encountered.

With these maxims in view, the machine was made as shown in the accompanying cuts, the pistons being



MECHANICAL SCRAPER, USED IN CLEANING ST JOHN, N.B, WATER MAINS.

of birch set in layers, each layer being one inch in thickness and placed crosswise of the other to prevent warping and increase the strength of the piston. Leathers were secured to the piston by means of an iron ring bolted against them, the bolts running through the piston. The spindle connecting the two pistons is of 3-inch wrought-iron pipe with a cast-iron flange screwed on each end and pinned over with a hammer to prevent the screw backing out. These flanges are each bolted through the piston to another flange on the opposite side. Projecting beyond the forward piston is an iron rod fitted with two sets of radial arms sloping back as shown in the cuts. There are four arms in each set made of No. 10 (B.W.G.) spring steel two inches wide, and each fitted with a forged steel scraper on the end, of the form shown in the drawings. The long sloping fish-tail form of this scraper enabled it to glide safely over every obstruction. In making the first runs, only one set of scrapers was attached; but in the latter, the whole eight were in use. This precaution was taken for the reason given, viz., lest a large amount of dirt should be loosened at once, and the cleaner become buried and stop.

A section of No. 2 main extending from the reservoir toward the city, a distance of about 6,000 feet, having been prepared by inserting a hatch-box at each end, the work of cleaning began on October 12th at 1 p.m., and was continued that afternoon. The head of water upon the upper hatch-box was 20 feet and on the lower 27 feet. The first run took four hours, for the reason that a cord sufficiently long to reach the whole length had been placed on a revolving drum 10 feet in circumference, and furnished with an indicator to register the revolutions. The end of this string was attached to the cleaner, and a record kept of its location as it sped along. But when the first flushing branch was reached the twine drifted out here and down the brook, while the drum kept on revolving and the indicator registering until the whole string was paid out. Meanwhile the cleaner had become securely moored near the flushing branch and could not be liberated until the stop-cock was dug to and uncovered. On the twine being cut and pulled out and the stop-cock lid restored, water was let on again and the cleaner finished its journey, a distance of 2,200 feet in about five minutes. This first run was sufficient to show that twine was dangerous, and we also learned that it was entirely unnecessary, for the grating sound of the cleaner as it passed through the pipe was heard quite distinctly by the two watchers under their feet as they followed the sound along the line. Two more runs were given that same afternoon, the time occupied to go the distance being about twenty minutes. The water was inky black for some time as it flowed from the flushing pipe, and it was allowed to run for two hours after the cleaner had been removed, this time having been required for the water to clarify.

The next section was taken on Saturday, October 23rd. It extended about 6,600 feet cityward, but in order to give the first section another scraping it was concluded to insert the cleaner at the dam and run it through the entire $2\frac{4}{10}$ miles. A misfortune was met this time in the following manner: The leathers having worn out during the first cleaning were renewed with a harder and stiffer quality than formerly, but they repeatedly caught in a new joint made while inserting the hatch box. Each time the lid was removed to ascertain why the cleaner did not start, it was found firmly fixed by this imperfect butt of the two pipe ends. After twice extricating it and again finding it caught in the same way, a jack-screw was applied to push it past this obstruction, the lid was again put on and the water let in at 4.05 p.m., and this time it started. At each of the five flushing stations the gate was left open fully ten minutes after the cleaner had passed, and then closed. As soon as the gate was closed the cleaner again proceeded, and the scraper, with only one piston, reached the end of its run at 5.25 p.m., having been one hour and twenty minutes going 2.4 miles, but when 50 minutes of a total stoppage are reckoned, the machine was found to have been in motion 30 minutes. As stated, only the forward part of the cleaner arrived, and search had to be made for the remainder. Nothing was done on the following day, which was Sunday, the castaway piston, which was lying obliquely somewhere in the pipe, having but partially obstructed the flow, and the water was left on until the Monday night following.

A receiving chamber unites Nos. 2 and 3 mains near No. 3 hatch box, and they are controlled by stop-cocks on each side of the receiver. It was, therefore, an easy matter to reverse the current of water in No. 3 by closing the stop-cock at the dam, and opening that at the receiver, as well as the flushing branches. This was done, and men were distributed along the line to listen for a rumbling noise, which at length was heard within about a quarter mile of hatch box No. 3, from which the cleaner had been extracted. The sound was followed along the line toward the reservoir until hatch box No. 2 was reached, when the derelict was taken out, after having travelled nearly a mile and crossed a valley about 90 feet in depth. It was found that the pressure of the jackscrew in forcing the cleaner past the uneven joint had cracked one of the flanges, with the result that after having travelled about $2\frac{1}{4}$ miles the cleaner fell apart. The forward part, comprising a piston and the scraper, pushed on, but the spindle attached to the rear piston fell to the bottom of the pipe, ploughed up some dirt and finally became embedded and jammed. The reverse current striking the piston as it did, drove it back with the spindle trailing behind. The apparatus was repaired and three more runs made through this double section of 12,600 feet, on October 29th, without any further mishap, the time taken for each run, including ten minutes stoppage at each of the five flushing stations, having been from 1 hour 46 minutes to 1 hour and 55 minutes. The cold weather being on when

the next castings arrived, cleaning operations were suspended for the season, to be resumed next spring.

On testing the efficiency of the cleaned main by shutting off No. 3 from the reservoir to the receiving chamber, where both unite, and bringing the supply through Nos. 1 and 2, it was found that the pressure in the city was as good as when No. 2 was shut, and the whole supply coming through Nos. 1 and 3, thereby showing that the capacity of No. 2 had improved to such an extent that whereas, with No. 1 it had formerly delivered to a height of 80 feet only, when unassisted by No. 3, and left 200 acres of the city, containing 8,500 inhabitants, without water, now the whole city could be supplied without the help of No. 3 and the water rise to a height of 130 feet above high water. The general improvement in pressure with all three mains on was found to be about four feet. Nearly two miles of this line remain yet to be cleaned, after which the other two. pipes will be taken as soon as the coming season permits

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*For* THE CANADIAN ENGINEER.

## TORONTO MAGNETIC OBSERVATORY.

BY R. F. STUPART, DIRECTOR OF THE OBSERVATORY.

The importance of obtaining a correct knowledge of the elementary facts of terrestrial magnetism, for the purpose of supplying a foundation whereon the advancement of that science on inductive principles may be based has for long been strongly and extensively felt.

From an early period of the meetings of the British Association for the Advancement of Science, the interest of terrestrial magnetism had received no inconsiderable share of the attention and exertions of its members. In the year 1834 a magnetic survey of the British Isles was commenced and carried through in the two following years by the joint labours of five of its members. In 1835 the association called for a report from one of its members, on the state and progress of researches regarding the geographical distribution of the magnetic forces on the surface of the globe; proposing to ground on the preliminary examination an application to the Government to aid in the prosecution of the enquiry in remote parts of the earth, unattainable by the means at the command of the association itself or of its individual members. This report, presented in 1837, was taken into consideration at the meeting of the association, at Newcastle, in 1838, and a memorial was addressed to the Government which, being favorably received by Her Majesty's Ministers, originated the naval expedition equipped in the following year for a magnetic survey of the high latitudes of the southern hemisphere. Deeming the opportunity a fitting one, the British Association availed itself of the same occasion to solicit the attention of Her Majesty's Government to the expediency of extending the researches to be accomplished by fixed observatories to certain stations of prominent magnetic interest within the limits of the British Colonial Dominions; the stations named were Canada and Van Diemen's Island, as approximate to the points of the greatest intensity of the magnetic force in the northern and southern hemispheres; St. Helena, as approximate to the point of least intensity on the globe, and the Cape of Good Hope as a station where the secular changes of the magnetic elements presented features of peculiar interest.

The committee recommended that the proposed colonial establishments should be placed under the general supervision of the Ordnance Department of the Army. The Government having expressed a desire that such extensive arrangement involving a considerable expenditure should be strengthened by the concurrent support of the Royal Society, a deputation was appointed to express the cordial participation of that society in the recommendation both of the Naval Expedition and of the fixed observatories. Arrangements having been completed, Lieut. Charles James Buchanan Riddell, R.A., was selected for duty in Canada, who, leaving his detachment, consisting of four non commissioned officers of the artillery, to embark with the instruments on a vessel bound direct to Quebec, proceeded himself to Canada by the more expeditious route of the United States; and having waited on the Governor-General at Montreal to present a letter of introduction with which he had been furnished by the Master General of the Ordnance, and communicated with the Commanding Engineer, to whom he was the bearer of instructions and authority to build an observatory, he proceeded to examine different localities which were suggested as convenient sites. The preference was finally given to Toronto, where a grant of two and a half acres of land belonging to the University of King's College was offered by the Council of the University. The first observatory building was of logs, roughcast on the outside and plastered on the inside; it was completed during the summer of 1840 and observations were begun in September. The operations of the observatory as an Imperial establishment were brought to a close in the early part of the year 1853, and were resumed under the authority of the Provincial Government in July of the same year.

In the autumn of 1853 the present observatory was commenced, to take the place of the old building. Very great care was taken during construction to insure all the stone used being entirely free from magnetism, and all nails and fastenings were of either copper or zinc. For twenty-three years the position of the Observatory was as far as is known, faultless, and observations were carried on systematically and carefully, and results given to the scientific world, which with those obtained under the old military regime, have made the Toronto Observatory famous in the history of terrestrial magnetism.

In 1876, however, trouble began with the building of the School of Science, which institution, however, being principally of brick and wood, caused but very small changes in zero values, which could be allowed for. Then followed a few years later electric light circuits which produced a change in the force instruments whenever the current was turned off or on, this difficulty was in part overcome by the Light Company courteously agreeing to arrange their wires in the vicinity of the Observatory in such a manner that currents should counteract each other. The next difficulty occurred when the addition was given to the School of Science, tons of iron being used in the construction of that building in an all too close proximity to the magnetic instruments, and much time and labor has been required to determine the precise effect of this "iron mine" on the various instruments. It was not, however, until the autumn of 1892 when the trolleys began to run that we began to suspect that sooner or later the Magnetic Observatory would have to be removed to another site.

The magnetic instruments in the Observatory consist of those brought out by Lieut. Riddell in 1840, of which eye readings have been taken six times each day, and of another set of similar instruments consisting of a bifilar for the measurement of the horizontal component, a balance needle for the vertical force and a declinometer, all of which record photographically.

Electric cars first ran in Toronto on August 17th, 1892; the line first put in operation was that on Church street, which was followed on September 5th by King street, between George street and Dufferin street. During

the first few weeks, while a very small vibration of the needle was discernible on the V. F. curve it was generally almost inappreciable, and it was not until September 20th that the movement increased to an extent sufficient to really impair the value of our magnetic curves; a marked increase of current must have been used on that day and afterwards. On October 10 the cars first ran on Yonge street, and there was only a very small increase in vibration, but a decrease of about .000070 of a dyne was observed when the current was on. About 10 a m., on the 14th January, there was a marked increase of vibration, and the vertical force increased about ·000200 one dyne. This disturbed period was only temporary, and shortly after 5 p.m. of the 17th there was a reversion to the smaller vibrations, which continued until May 15th, when very large vibrations began again and continued with varying intensity during the summer, while the decrease of the V. F. with the current ranged from about ·000200 to ·000500. This disturbance was very great between September 12th and October 17th and at intervals during the following year, but there was no radical change in conditions until December 17th, 1894, when a decrease of V.F. while the current was on, was changed to an increase, this occurring when the cars first ran on McCaul street. Throughout 1895 the vibration and amount of permanent deflection was very nearly as it has been since, but on October 15th the increase of V. F. with the current was again changed to a decrease, this occurred at the time that the railway company made certain changes in the feed wires. It is noticeable that although several changes occurred in the V.F., it at times having been less with the current on and at other times greater. The horizontal force showed a steady decrease on all occasions with the turn on of the current, which during the past two years has been ·000200 to ·000500. No appreciable deflection of the declinometer magnet can be noted, the only effect being a continuous vibration which has rendered the curves very ragged and difficult to read with accuracy.

A study of the traces during the times that the various electric lines were put in operation shows that with the currents ordinarily used there is little effect at $\frac{3}{4}$ mile, and a further survey with a portable instrument affords further evidence in the same direction; it has, therefore, been determined to remove the magnetic instruments to a point distant two miles from any probable trolley route and about nine miles from the present location, and continue what is certainly the most valuable and extended magnetic records outside of Europe.

NOTE.—The history of the establishment of the Observatory at Toronto is taken from the early reports.—R. F. S.

## PROCEEDINGS OF THE THIRTEENTH ANNUAL MEETING OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS, AT PEORIA, ILLINOIS.

The Illinois Society of Engineers and Surveyors assembled in thirteenth annual meeting in the rooms of the County Superintendent of Schools, in the court house, January 26th. The executive secretary's report showed the society to have eighty-one old members in good standing, and during the course of the meeting twenty-two new members were added. After the secretary's report had been read, C. C. Stowell, president of the society, delivered his annual address. The report of the waterworks committee was presented by Dabney H. Maury, jr., chairman. This report gave information regarding the rules, regulations and rates of water companies throughout the State of Illinois. The secretary read a paper on "Railroad Construction in Mexico," by L P. Atwood, engineer of the maintenance of way of the Rio Grande, Sierra Madre and Pacific Railway. Mr. Atwood also presented a detailed account of the cost of steel tie plates used in the construction of this road. John T. Stewart, of Paxton, gave his experience as a leveler for the United States Geological Survey, in running lines in the Black Hills country. S. S. Greeley gave an interesting discussion upon the topic, "The Status of the Surveyor of Illinois; Is it a Profession or a Trade?" His conclusions went to show that surveying is one of the liberal arts; a profession, and not a handicraft or trade. He argued strongly for the licensing of surveyors and engineers, referring to the recent Act of the Legislature of Illinois requiring architects to be licensed.

The evening session, which was held at Bradley Hall, was given up to a description, with stereopticon illustrations, of the Peoria Park system, by R. R. Bourland, O. F. Du Buis and L. K. Dowein. The exercises were opened by an address of welcome by Hon. John Warner, mayor, which was followed by an address to the engineers by Hon. O. J. Bailey, president of the Polytechnic Institute. Before the opening of this session members of the society inspected the Bradley Polytechnic Institute. Thursday morning, Prof. Wm. D. Pence, of the University of Illinois, read a paper on the Graphical Representation of the Magnetic Declination, describing in a very interesting manner the daily and annual movements of the magnetic needle. P. C. Knight, chairman of the Drainage Committee, submitted his report on drainage and gave a description of the drainage of the Meredosia swamps in Whiteside county. Centrifugal pumps are used, having a daily capacity of 36,000,000 gallons of water per day with a lift of sixteen feet. An interesting paper upon the purification of sewage by the Ferozone Polarite System, as observed at Acton, England, was presented by John V. Alvord, Chicago. The discussion which followed the reading of this paper indicated that this system is to be adopted in the vicinity of Chicago at an early date. One of the most valuable papers which was presented to the society was on "Water Analysis," by A. W. Palmer, Professor of Chemistry at Champaign. Prof. Palmer being in charge of the sanitary survey of the waters of the State of Illinois, has much information upon this subject.

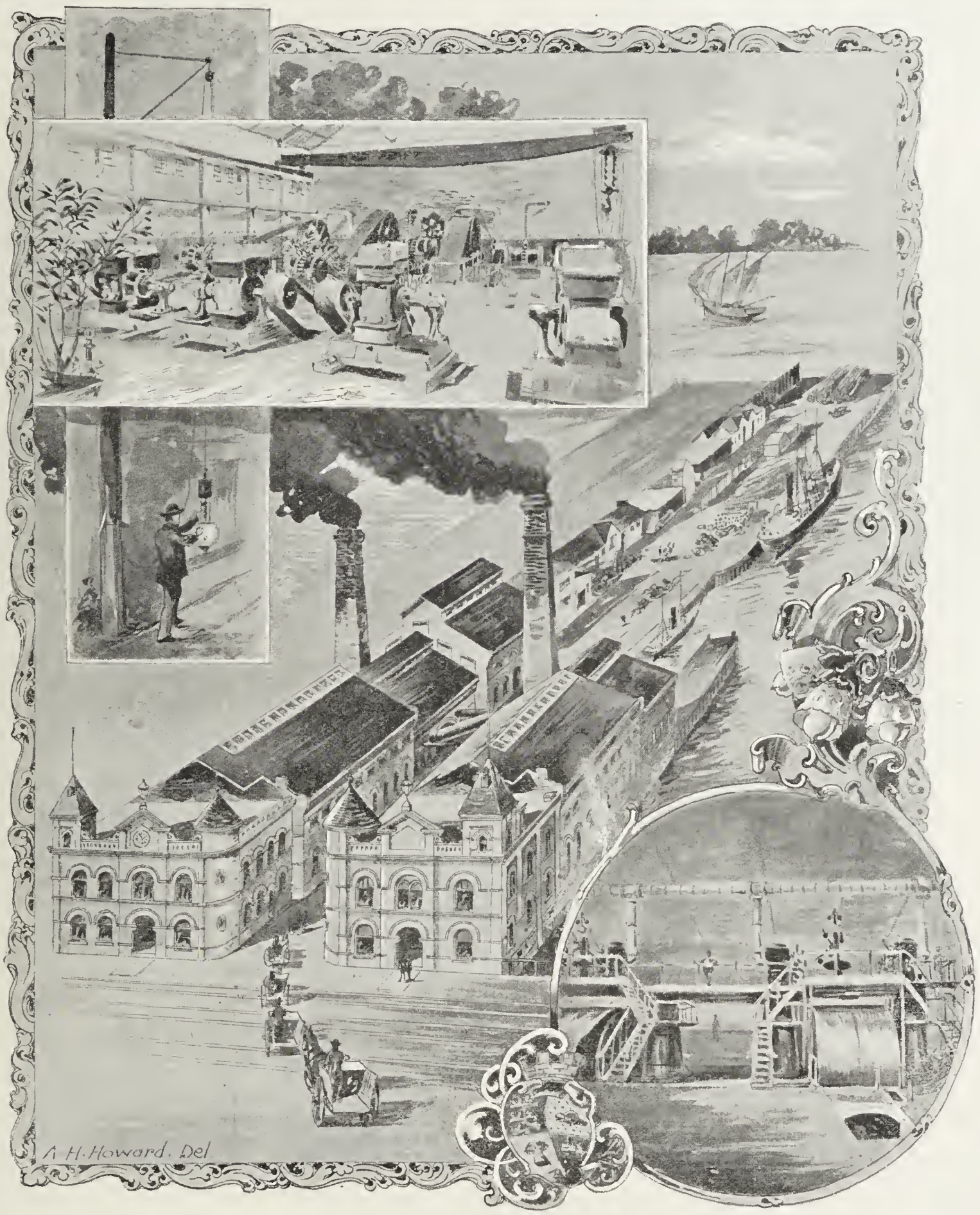
The afternoon of Thursday, the 27th, was devoted to an inspection of the Peoria water works plant and the Atlas distillery. At the evening session, Charles H. Nicolet, chairman, read the report of the committee on Municipal Engineering. A paper on Proposed State Supervision of Water Supply and Sewage Disposal was read by Jacob A. Harman. This paper gave a record of the efforts of the engineers and physicians of the State to have a bill passed providing that the State Board of Health should have control of the water supply and sewage of the State. The following officers were elected for the ensuing year: President, A. D. Thompson, Peoria; vice-president, W. A. Darling, Rock Island; executive secretary and treasurer, Jacob A. Harman, Peoria; recording secretary, J. C. Quade, Kewanee; trustees, W. D. Pence, Champaign; S. S. Greely, Chicago; C. C. Brown, Bloomington.

Friday, the 29th, the last day of the session, was devoted entirely to the reading of papers and committee reports and discussions. Prof. A. N. Talbot, of the University of Illinois, presented a report for the committee on paving brick specifications, and recommended that the society adopt certain uniform methods of testing. This report was finally referred back to the committee for further investigation to report at the next annual meeting. The first paper on the programme was "Deep Well Pumping," by E. E. Johnson, of Chicago. His paper gave very valuable data with reference to the air lift pumps and other systems of deep well pumping; he also exhibited a model of a new design of deep well pumping, which shows a great economy over any forms of deep well pump heretofore in use. S. S. Greeley, chairman, reported for the committee on the metric system, and a resolution was passed endorsing the adoption of the metric system for general use in the United States. Mr. J. E. Miller read a paper on "Brick and Macadam for Country Roads," describing work which had been constructed north of Monmouth, Ill. J. T. Schmeltzer, Mantino, read a paper on Improving the Roads of Illinois A most interesting paper on the road problem was that on The Improvement of Transportation in Country Districts, by E. E. R. Tratman, Chicago, resident editor *Engineering News*. A. Lagron reported for the committee on Public Highways, and showed a disposition to discourage action upon the subject by engineers because of the lack of interest exhibited by the farmers, or those who have most use for the roads. M. Huebinger, Peoria, presented a paper on City Map Making. After numerous resolutions, and installation of officers, the society adjourned.

AN Ontario charter has been granted to G. B. Meadows, A F. Ede, Rose Ellen Meadows, May K. White, and T. Urquhart, Toronto, Ont.; W. G. Meadows, Buffalo, N.Y., as the George B. Meadows Toronto Wire, Iron and Brass Works Company, Limited, to manufacture and deal in wire, wire-cloth, wire-fabric, wire goods, ornamental wrought iron-work, fencing, art metal goods, bank and office-railings, window-fixtures, display-stands, brass and brass goods, iron or wire-cots and bedsteads, elevators and elevator-coverings.

## THE NEW WORKS OF THE TORONTO ELECTRIC LIGHT COMPANY.

We are enabled in this issue to furnish our readers with some views of the new buildings of the Toronto Electric Light Company. It will be remembered that on the 21st of January last year, a destructive fire occurred, causing a loss of the arc lighting station of the company. Some effective work was done in providing temporarily for the illumination of the streets until permanent quarters could be provided for a new plant. The location of the works is one of the best that could possibly be chosen for a central distributing station. It is upon the water front of the city and at the foot of its principal thoroughfare and business centre. Unlimited water is available for condensing purposes and facilities for the unloading and storing of coal, both from cars and vessel, are of the best. In re-building it was determined to eliminate altogether the risk of loss and interruption by fire, and the new buildings are therefore constructed exclusively of iron, brick and stone. There is absolutely no wood used in their construction. The arc light station, No. 1, of which two views are shown, was completed about the first of September last, and is 165 feet in length by 68 feet wide. The foundation rests upon piles which were driven to the solid rock, and upon these a bed of concrete two feet nine inches thick was laid over the entire surface. Upon this the dynamos and engine foundations were build of hard brick and cement. They were raised high enough to permit of good head-room below, and the floor was formed of brick arches. resting upon these foundations and upon I beams and iron pillars in the intermediate spaces. In the tunnels thus formed the driving shafts are placed. The dynamos are driven by belts passing through apertures in the arches to the floor above. There are in this building two compound condensing engines of 350 h.p. each, and two pairs of high-pressure condensing engines of 450 h.p. The shafting is all 6 inches in diameter, and runs on self-oiling bearings, being driven from the engines by triple leather belts 38 in. wide. A twenty-ton traveling crane is constructed to cover the entire floor space. This has been of the greatest value in placing the machinery in position, and when repairs are required, will be able to handle the heaviest piece of machinery at a minimum of both time and expense.

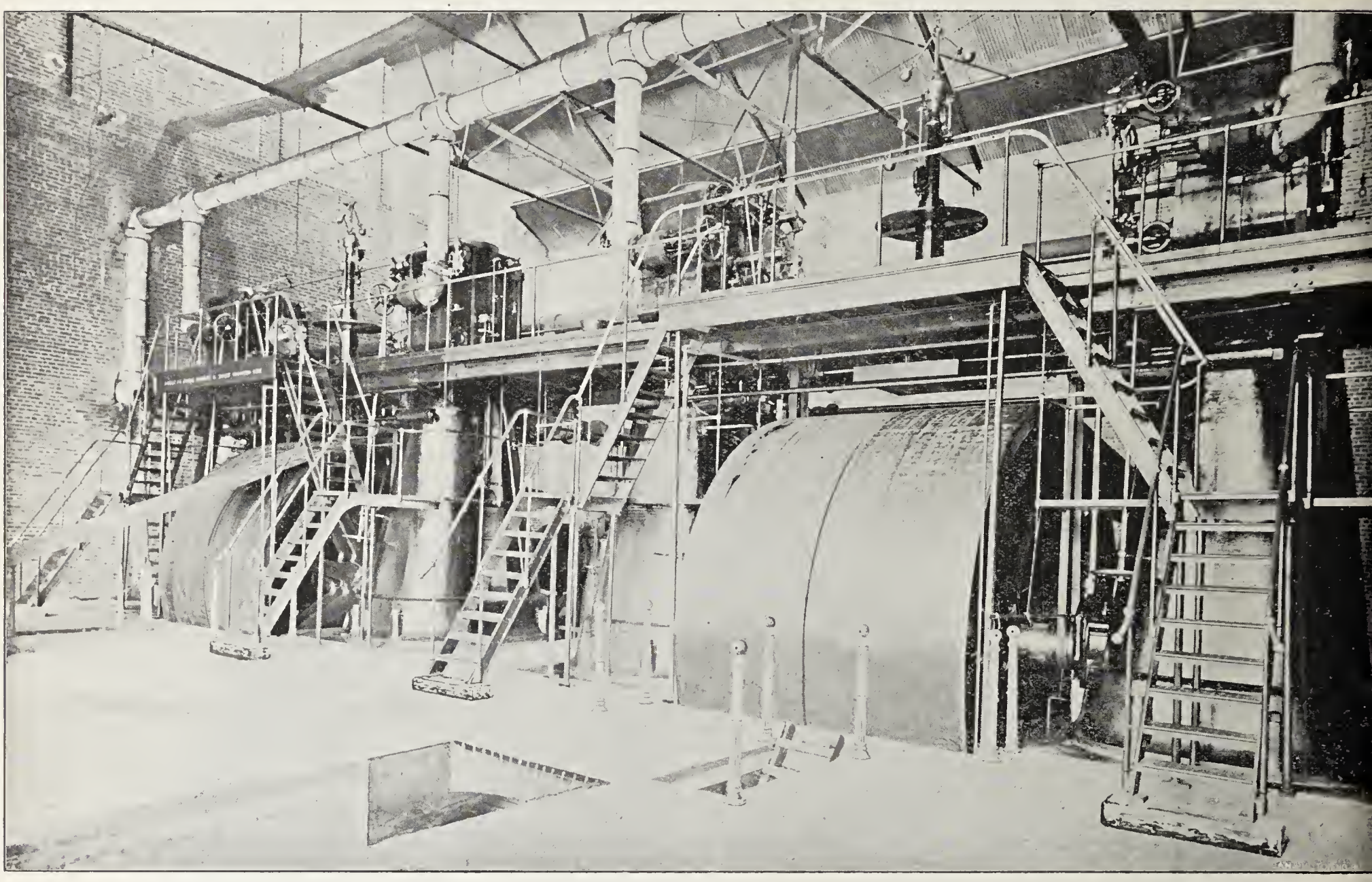



THE SCOTT STREET POWER HOUSE AND DOCK OF THE TORONTO ELECTRIC LIGHT COMPANY, LIMITED.

The arc light switchboard, which extends across one end of the building, is somewhat unique in both its methods and construction. It is built of pressed brick, with terra cotta facings. The terminals of the circuits are mounted on glazed tiles let into the face of the work. Ampere meters for each circuit are also mounted on other glazed tiles, and are large

enough to be seen from any part of the building. It is not necessary for the attendants to go to the switchboard, but they can see the state of the various circuits at any time, and wherever they may happen to be. Behind the wall constituting the board is a slate shelf, extending the entire width, to accommodate a standard ammeter or other testing instruments, which can be plugged in any circuit at any time by means of spring-jacks in each line. In each line also is a polarity indicator to ensure the correct direction of the arc lighting currents. The whole is surmounted by an electrically-driven cock, also built of brick, with a dial 6 feet in diameter.

Immediately adjoining this building, and forming the front premises, as seen at the left-hand of the engraving, is another fire-proof structure, which will be used as store-rooms for all kinds of supplies and show-rooms for incandescent fixtures, etc., and a completely fitted up meter department having all the latest appliances for repairing, reading and testing the various kinds of meters in use in the business. No. 1 boiler-house has re-erection. It is now a frame iron-clad structure, lined inside and on all the joists and timbers with sheet-iron. It is intended to replace it as soon as the weather permits with an iron and brick structure to match the others. The foundation work is now all completed and ready for the walls. As it is proposed to replace the building without interfering with the operations going on inside, considerable ingenuity will have to be exercised to avoid stoppage of the machinery for any considerable length of time. The building contains a double upright tandem condensing engine of 1,000 h.p., besides dynamos of all classes, arc light alternating and direct-current power machines, besides a pair of 110-volt machines that are supplying the underground mains of the Edison system in conjunction with the generators at the Teraulay street station of the company. At one end of the building is located the general switchboard controlling the entire output of electricity for all purposes. One attendant thus has under his hand the output from all the buildings except the arc light.



3,000 H.P. Engines in No. 3 Station, Toronto Electric Light Co.

also been re-built, and has an iron roof with swinging sash for light and ventilation. This boiler-room contains three Heine water tube boilers of 250 h.p. each, and 10 return tubular boilers of 120 h.p. capacity each. No. 2 boiler-house, opposite, has two 250 h.p. Heine boilers, and two 250 h.p. Caldwell water tube boilers, with capacity for as much more.

Station No. 3 is a handsome fire-proof building, with iron roof and stained-glass windows. It is used for production of electricity for motor power and incandescent lighting. It contains two pairs of vertical Corliss engines of from 1,000 to 1,500 h.p. each. These are shown in the engraving. At the time the views were taken the ornamentation of the building was not completed. The brick walls which are shown bare, are colored a cream tint, with chocolate-colored dado and frieze. There are four dynamos only in this building, but they are machines of great capacity. Two of them being direct current 250-volt generators of 500 kw. each, and two double armature alternators of 450 kw. each. The air pumps of these engines are driven by independent Corliss engines, and make a very complete and satisfactory arrangement. The dimensions of this building are 80 feet by 68 feet.

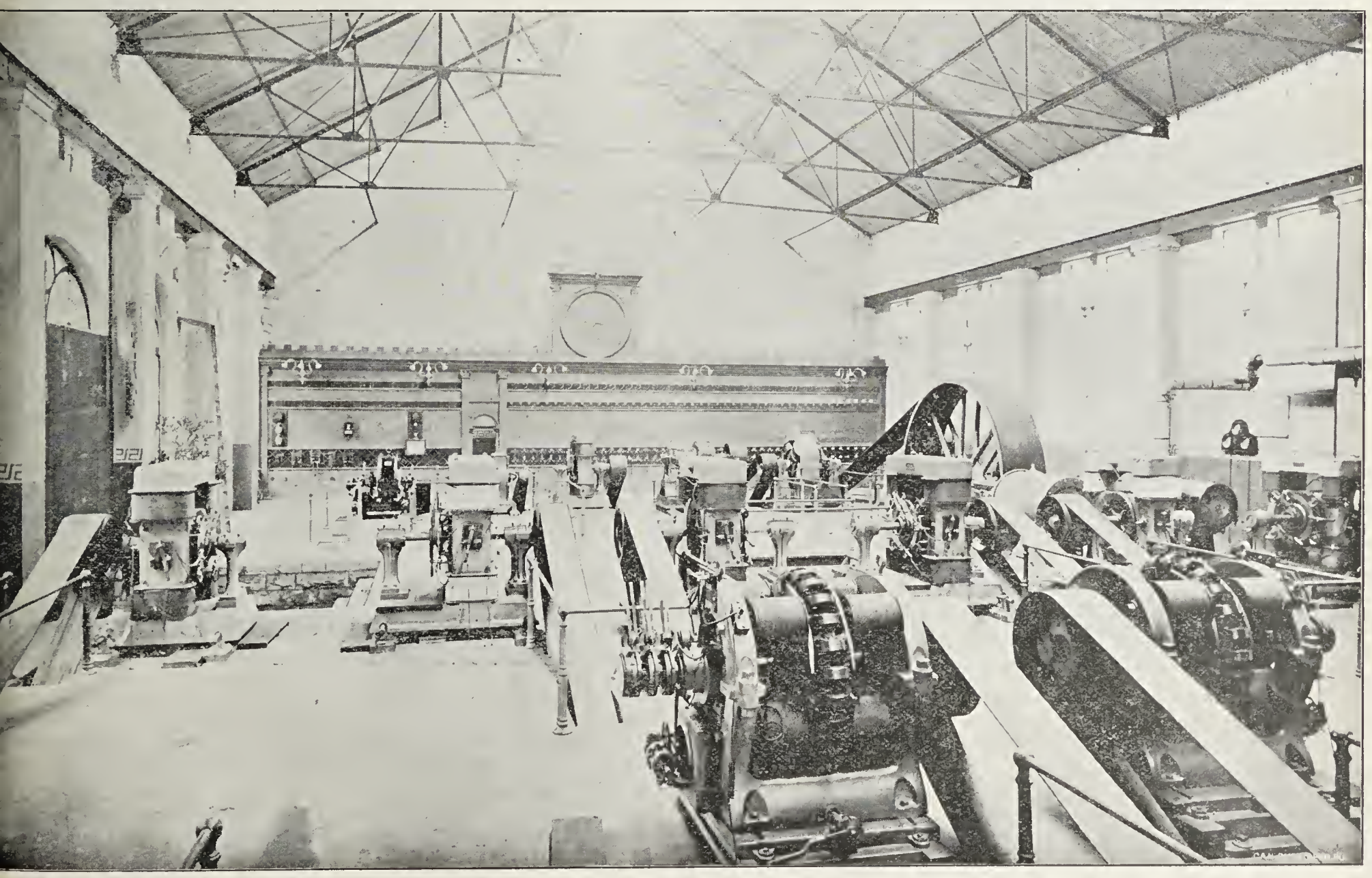
Station No. 2, which is the building immediately in rear of the offices, shown on the right of the view, is now in course of

At the further end of the lot is a spacious wharf on which will be erected for the opening of navigation an extensive coal storage plant and electric hoist for unloading vessels. Adjoining this are the stables with accommodation for 30 horses. linemens' quarters, lamp inspectors' and trimmers' room, carpenter shop, store-house, blacksmith shop, and a commodious machine shop, where a large amount of manufacturing is being carried on, as well as all the repair work necessitated by the operations of the company.

When the contemplated improvements are finished, the entire installation will be one of the most complete and up-to-date to be found in the country. The entire work of re-building has been done by day labor by the employees of the company, even to the construction of the iron roofs. The design and execution of the various works are creditable to the management and the efficient staff having charge of the various branches of the work.

While the air is charged with rumors of so-called "cheap power" and various schemes, "fake" and otherwise, are being promulgated, the Toronto Electric Light Company are steadily proceeding with their developments. They are, it is claimed, producing power at the present time quite as cheaply as it can be transmitted from Niagara or any water-power, and the con-

ENGINE END OF NO. 1 ARC LIGHT STATION, TORONTO ELECTRIC LIGHT CO.



SWITCHBOARD END OF NO. 1 ARC LIGHTING STATION, TORONTO ELECTRIC LIGHT CO.

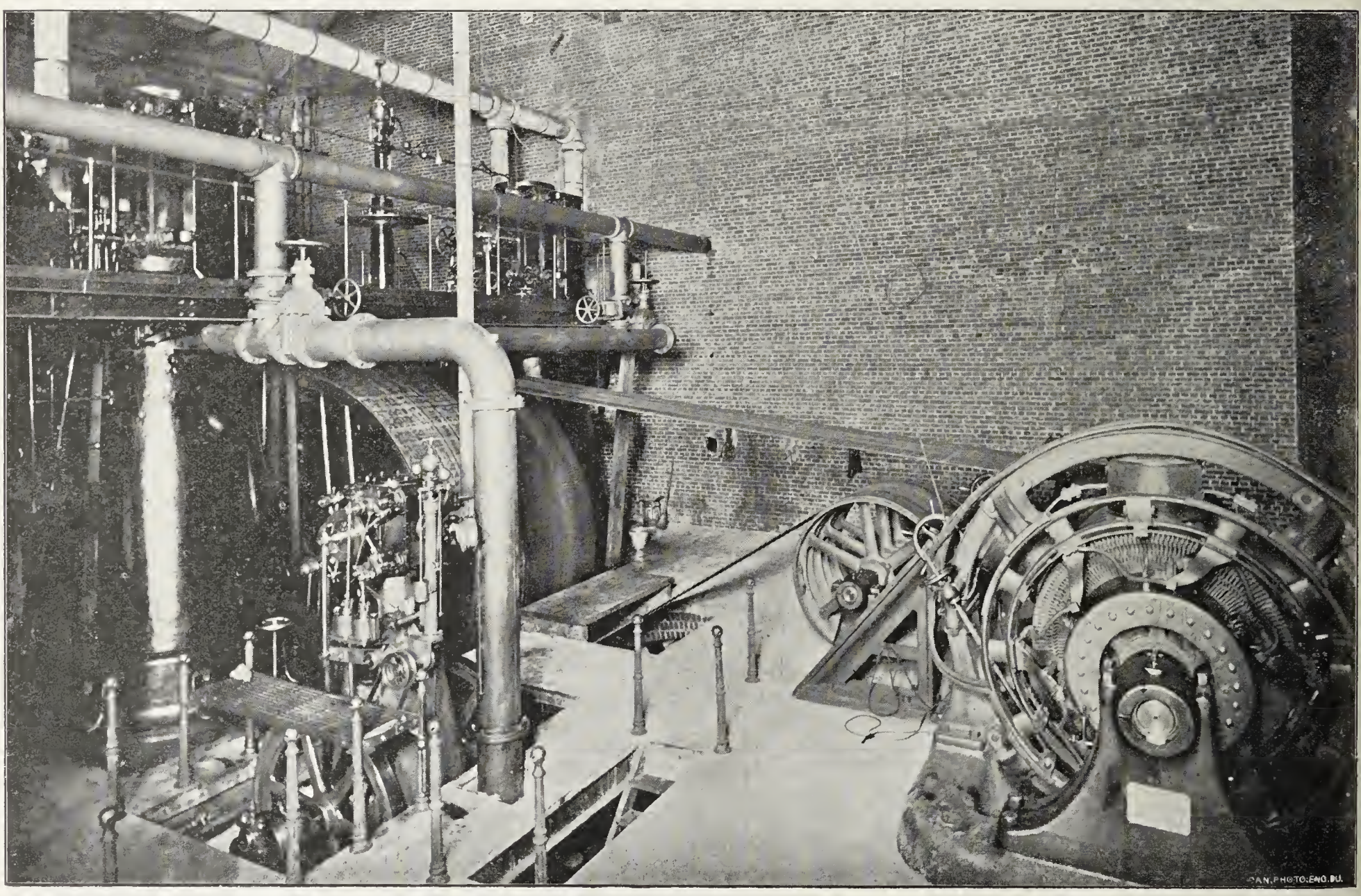
templated installation of coal-handling apparatus to further reduce the cost will enable them to compete with electricity produced from any source. The rate at which power is being sold in Toronto, namely, 2 cents per horse power hour for 10 h.p., is said to be the lowest on the Continent of America to-day from a plant of a similar nature.

J. J. WRIGHT.

J. J. Wright, manager of the Toronto Electric Light Company, whose name is very well known in connection with the development of the electric lighting industry in Toronto, is one of the pioneers in the business of producing electricity for industrial use. He was born in Yarmouth, England, in 1850, and was educated at Shireland Hall, near Birmingham, and subsequently served some years at mechanical engineering. His father was a minister of the Methodist Church in England, but as he died while the subject of our sketch was but a youth, there were no ties to bind him to the Motherland, and Mr. Wright, like many others, in the early seventies struck out for the New World and landed in Canada some twenty-seven years ago. He went to Philadelphia at the time of the Centennial Exhibition of 1876, at which time electricity was beginning to attract attention as a commercial possibility. He there became acquainted with Professors Thomson and Houston, then members of the faculty of the High School at Philadelphia, and constructed for them some of the earliest experimental dynamos, crude enough in themselves, but the embryos from which have sprung some of the brilliant results of to-day. Mr. Wright constructed some of the first lamps used for street illumination, and was among the first to handle electric light wires in the construction of under-ground service, having constructed a line of under-ground wire for electric lighting in Market street, Philadelphia, between the City hall and Fourth street, in the year 1881. He was a member of the Franklin Institute of Science and Arts, and also a member of the National Conference of Electricians, convened by the United States Government.

In the spring of 1883 Mr. Wright returned to Canada and commenced the construction of the first plant for the distribution of electricity in this part, if not in the whole of Canada. It was located near the corner of King and Yonge streets, Toronto, and was the nucleus from which has sprung the extensive electric lighting interests of the city of to-day. When the Toronto Electric Light Company was organized the original plant was absorbed in the new company, and since that time Mr. Wright has filled the position of general manager. He has been three times elected president of the Canadian Electrical Association, and one of his most cherished possessions is a handsome gold watch that was presented to him at the close of his first year of office by members of the association.

Mr. Wright built and operated the electric locomotive that was for several years used at the Industrial Exhibitions in Toronto. This was the first electric railway in Canada, and during the years of its operation successfully carried many thousand of passengers. Mr. Wright was the recipient of an engrossed resolution and handsome testimonial from the Exhibition directors for the successful carrying out of what was then a new and untried service.



DIRECT CURRENT GENERATOR, 250 VOLTS, 500 K.W., TORONTO ELECTRIC LIGHT CO.

The design and construction of the new work of the Toronto Electric Light Company, which we illustrate in this issue, is Mr. Wright's latest work, and is one that has been most highly spoken of by more than one who is in a position to be a most competent judge.

## THE CHEMISTRY OF FOUNDRY PRACTICE.

BY ERNST A. SJOSTEDT.

Compared with the chemistry of the blast furnace process (in which the ores are deprived of their O., and the reduced metal combines with elements like carbon, silicon, manganese, etc.), and the different processes of iron and steel making (whereby the said foreign ingredients are oxidized and eliminated to a more or less complete degree), the chemical changes taking place in the cupola, where the metal is merely re-melted, are quite simple. Nevertheless, these changes, small though they be, are sometimes of great practical importance, and as the physical qualities of the castings (such as strength, hardness, elasticity, etc., are very largely dependent on the chemical composition of the metal, it is evident that the adaptation of chemical researches in connection with the foundry practices are well deserving of a most careful attention. The importance and necessity to the blast furnace manager and the steel worker of applying chemistry in their daily practice has long been recognized; but it is quite recently that the services of the chemist have been called upon to help solving the many puzzling problems which the foundryman constantly encounters. However, his legitimate place and position is already well established at the larger foundries in the United States and in Europe, besides at such works where a specialty is aimed at (such as car wheels and malleable castings), and the smaller foundries are slowly following their example.

In the hopes of arousing some interest in this important subject also (in this country, and especially) among the members of this association, the following notes and facts are hereby presented as a nucleus for discussion, founded as they are on the best authorities, and in all essential parts having been found correct and a most valuable help to the writer, in connection with his labors and investigations as chemist at different iron and steel works. Even at the risk of appearing pedantic, the writer has aimed at making this treatise as elementary as possible, in order to interest those least familiar with the subject, and must therefore, ask of the well-informed members their kind forbearance.

As we all know, absolutely pure iron does not exist as a commercial product, for what we are working and dealing with is not a single substance, but an alloy, composed of a number of elements in different proportions, the total sum of which, however, seldom exceeds 5 to 10 per cent. Among these elements, carbon is an essential constituent, and one that plays a most important role in determining the physical character of the iron. In fact, its influence on the iron is so great that its presence in smaller or greater amounts is responsible for the three well-known classes—with so distinctly different characteristics—in which iron has been divided, namely, wrought iron, steel and pig-iron: pig-iron containing about 2.5 to 5.0 per cent. of carbon, steel, from .4 to 2.5 per cent., and wrought iron, from about .03 to .35 per cent.; and their characteristics are so familiar to us all that it is here only necessary to recall their different melting points, which for pig iron is from 1,800 deg. F. to 2,200 deg. F., for steel, about 2,650 deg. F., and for wrought iron, about 2,880 deg. F. Again, we must carefully keep in mind that carbon, in pig iron, occurs in two conditions which are distinct in their physical and chemical relations, namely, as graphite and as allotropic modification, combined carbon. If present as graphite (i.e. simply mechanically mixed with the iron), the pig has a gray, soft fracture, but when in chemical union with the iron, the fracture is white and hard, with metallic lustre. In molten pig iron all the carbon is present in its combined form, and it all depends on the time and conditions allowed during cooling, which state—graphitic or combined—it will assume in the casting; the slower the cooling is taking place the better opportunity the carbon will have to crystallize (forming graphite), and the grayer the iron becomes; whereas, if made to cool suddenly (as when poured against a chill block) the carbon is not given this opportunity, and consequently, it is retained, more or less, in its combined state, and the iron becomes hard and white—always provided no other strong agent is present that will break this rule, and of which we will speak presently. The carbon, per se, as long as it remains combined in the pig iron, increases the absolute tensile strength of the iron, but when separating as graphite, it makes the iron weaker, it also increases the hardness, but decreases the elasticity and the melting point of the iron (i.e. white pig iron is somewhat easier to melt than gray). The following analyses of combined and graphitic carbon in a certain coke iron (Embreville, Pa.), will give a clear idea of the influence which the different modifications of carbon exert on the fracture of the pig:

| | Per cent. | | | Per cent. |
|---|---|---|---|---|
| No. 1 foundry pig..... | 3.80 | graphite and | .10 | C.C. |
| No. 2 foundry pig..... | 3.78 | " " | .25 | " |
| No. 3 foundry pig..... | 3.60 | " " | .39 | " |
| Gray forge ..... | 3.00 | " " | .70 | " |
| Mottled ..... | 1.50 | " " | 1.70 | " |
| White ..... | .10 | " " | 3.10 | " |

Among the other elements usually present in the pig iron, and the one next to carbon in importance, as regards its effect on the iron, we must place Silicon. Silicon, namely, exerts a controlling influence on the chilling properties of the iron, owing to its tendency of separating the carbon as graphite. Its percentage in the pig iron is generally in proportion to the temperature at which it has been produced. Thus, a coke iron is higher in silicon than a charcoal pig, and varies from a few tenths of one per cent. (as in Swedish charcoal pig), to 1.5 and 2.0 per cent. (in iron usually suited for machine castings), and runs as high as 2.5 to 3.5 per cent. in good soft coke iron; and the "silvery iron" contains about 4 to 5 per cent. silicon alloys with iron in greater proportions than carbon (ferro-silicon contains 30 to 50 per cent. Si.), and decreases the absorption of carbon. Hence, coke iron is generally lower in total carbon than charcoal pig, and iron with 2 per cent. silicon and no manganese has seldom more than 3.8 per cent. C. It increases the fluidity and fusibility of the iron, and lowers its smelting point, makes the iron retain its heat for a longer time, and thus lessens the formation of blow holes, and decreases the shrinkage (in proportion to the amount of graphite that has separated). Added to "pure cast iron" it has been found to improve the strength of the iron up to 2.5 per cent., but above this amount it makes the iron weaker. From the above properties of the silicon it is easy to see why it is that pig iron which contains a high percentage of silicon acts and is used as a "softener," and that by melting various portions of such iron with hard iron, all the different grades can be obtained, from close to very open-grained soft iron. In re-melting pig iron loses about .25 per cent. of silicon, which should not be forgotten. Another disturber of the equilibrium in a pig iron is sulphur. Contrary to silicon, sulphur present prevents the formation of graphite, and consequently, it has a tendency of producing a white, hard casting: it also makes the iron sluggish and full of blow holes, sulphuretted hydrogen gas, causes red shortness, and increases the shrinkage. Besides, being generally irregularly distributed in the iron, sulphur tends to make an uneven, unreliable casting. For these several reasons sulphur has well been called "the foundry man's bane," and owing also to the hindrance it offers to annealing, it should especially be avoided in malleable castings, also in iron intended for car wheels. Sulphur has a great affinity for iron, combining with it at a lower temperature, and in any proportions, up to about 53 per cent., and as its evil effects are perceptible already at a fractional part of one per cent., it must be a matter of great importance for the foundryman to keep track of this element. As a general thing it is rarely found in a soft, open foundry pig—for its presence to any high degree would make the iron more or less close-grained or white—and this great enemy, therefore, is not always shunned as much as it deserves; but its presence in the coke, and sometimes also in the limestone, is certain to bring it in the casting, and thus it happens that a good iron often has been condemned when the fuel and the flux alone were to blame. Good Connelsville coke contains seldom over .6 per cent. sulphur, but at many a foundry 1.0 per cent. S. in the coke is not unusual; and if a basic change and a high temperature be not resorted to in the cupola the iron, in re-melting, will increase .2 to .5 per cent. in sulphur, which is sufficient to spoil it for most purposes, if the silicon be not present in sufficient quantity to neutralize its effect.

To be continued.

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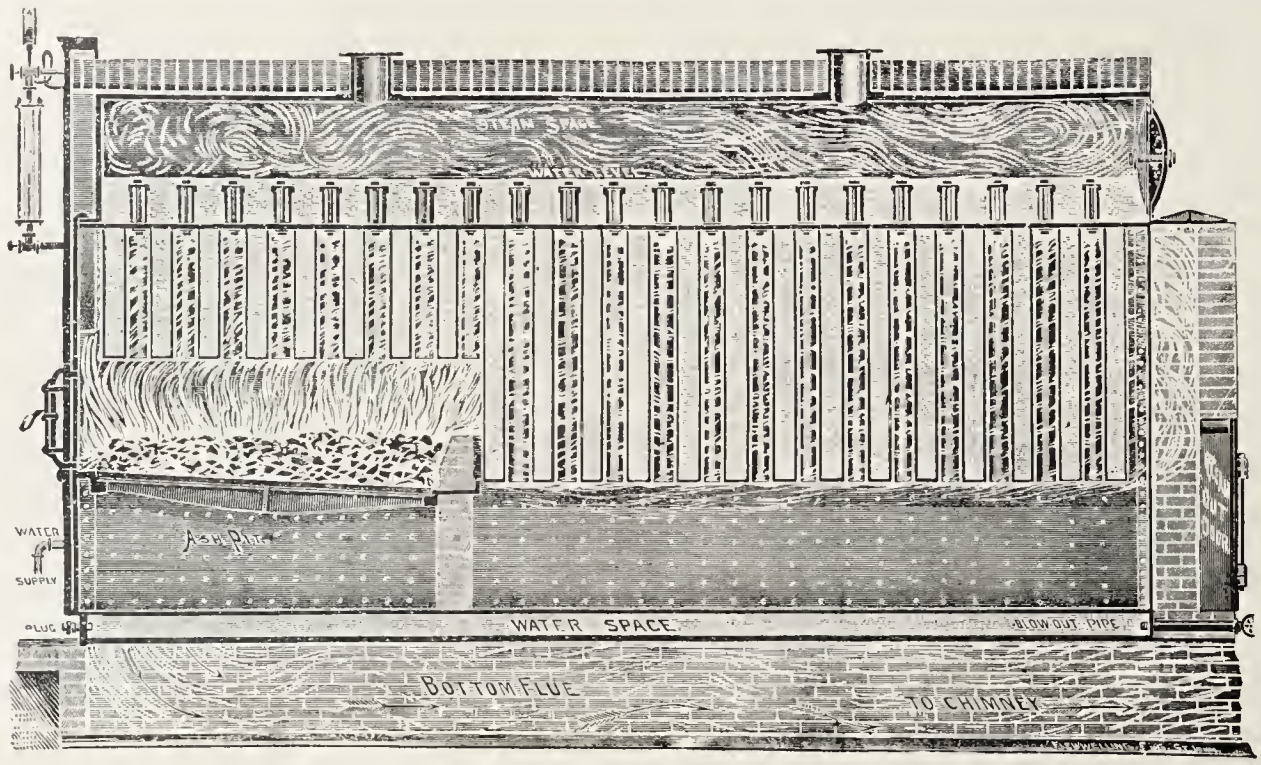
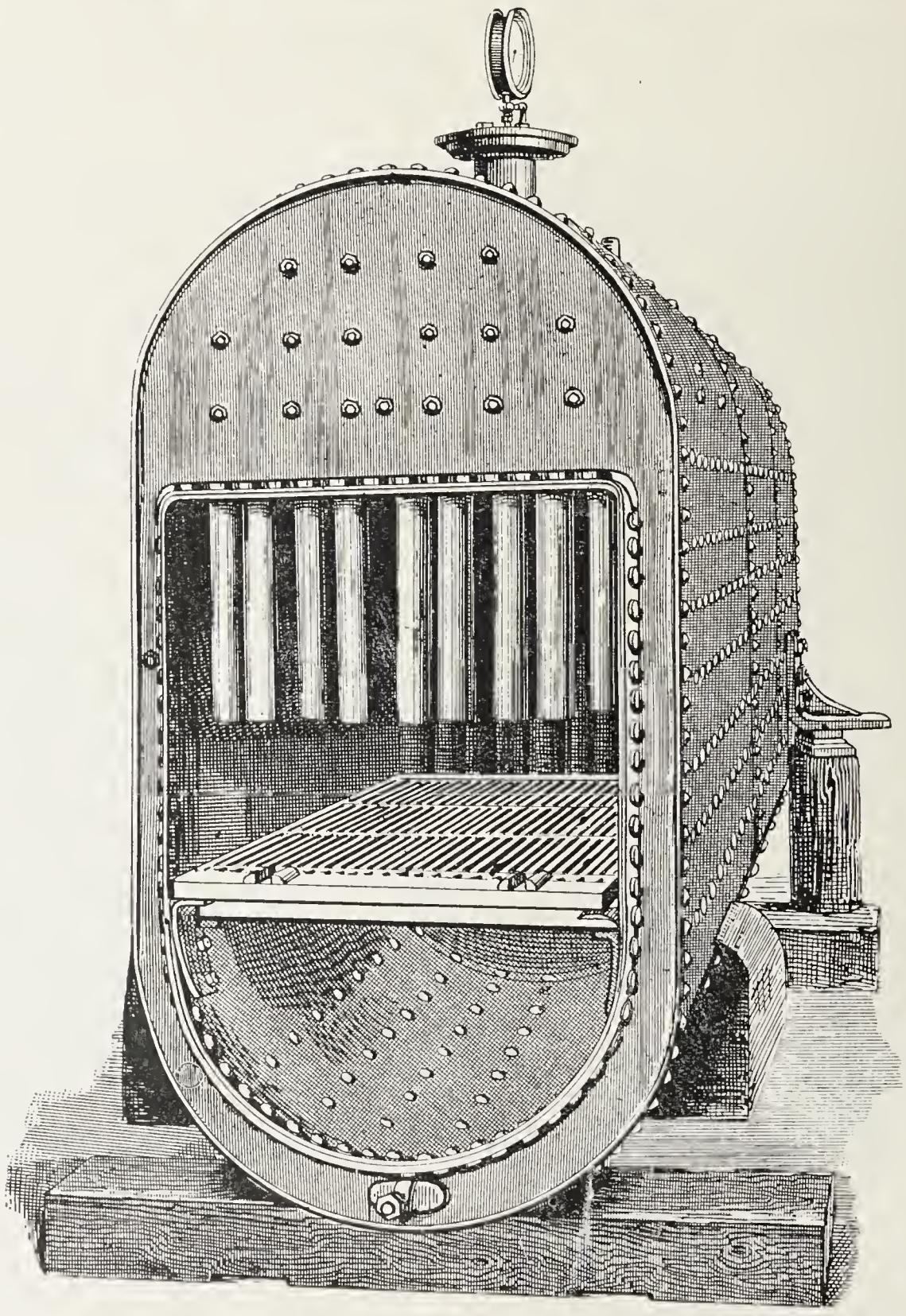
Two or three years ago marl beds were discovered near Orangeville, Ont., and D. B. Brown, T. M. Rowan, R. H. Gillespie, and J. M. Rowan have acquired 500 acres of land in the township of Caledon, within three miles of Orangeville, 400 acres of which contain a bed of marl, varying in depth from eight to twenty-one feet. The marl is pronounced to be particularly good, and suitable for making Portland cement, etc. It will likely be developed at an early date.

## KINGSLEY WATER-TUBE BOILERS.

The Kingsley patent water-tube boilers, herewith illustrated, are constructed with two shells—an outer and an inner. The outer shell has vertical parallel sides and semi-circular top and bottom. The inner shell is fixed parallel to the sides and bottom of the outer shell, by means of two flanged heads and numerous stay-bolts, leaving a uniform space about four inches wide between the two shells extending the full length of the boiler. The crown sheet is horizontal, and extends continuously the entire length of the boiler. It is flanged down three inches along each side for its entire length, and forms the top of the inner shell by being riveted to it along each side. The tubes are threaded at their upper ends with standard pipe threads, and are screwed into the crown sheet. The bottom ends of the tubes are plugged with ¼-inch iron and are then welded solid. The tubes are made of standard 2-inch iron lap-welded pipe. They are short enough in the fire-box to leave




The Kingsley Patent Drop Water Tube Boiler.

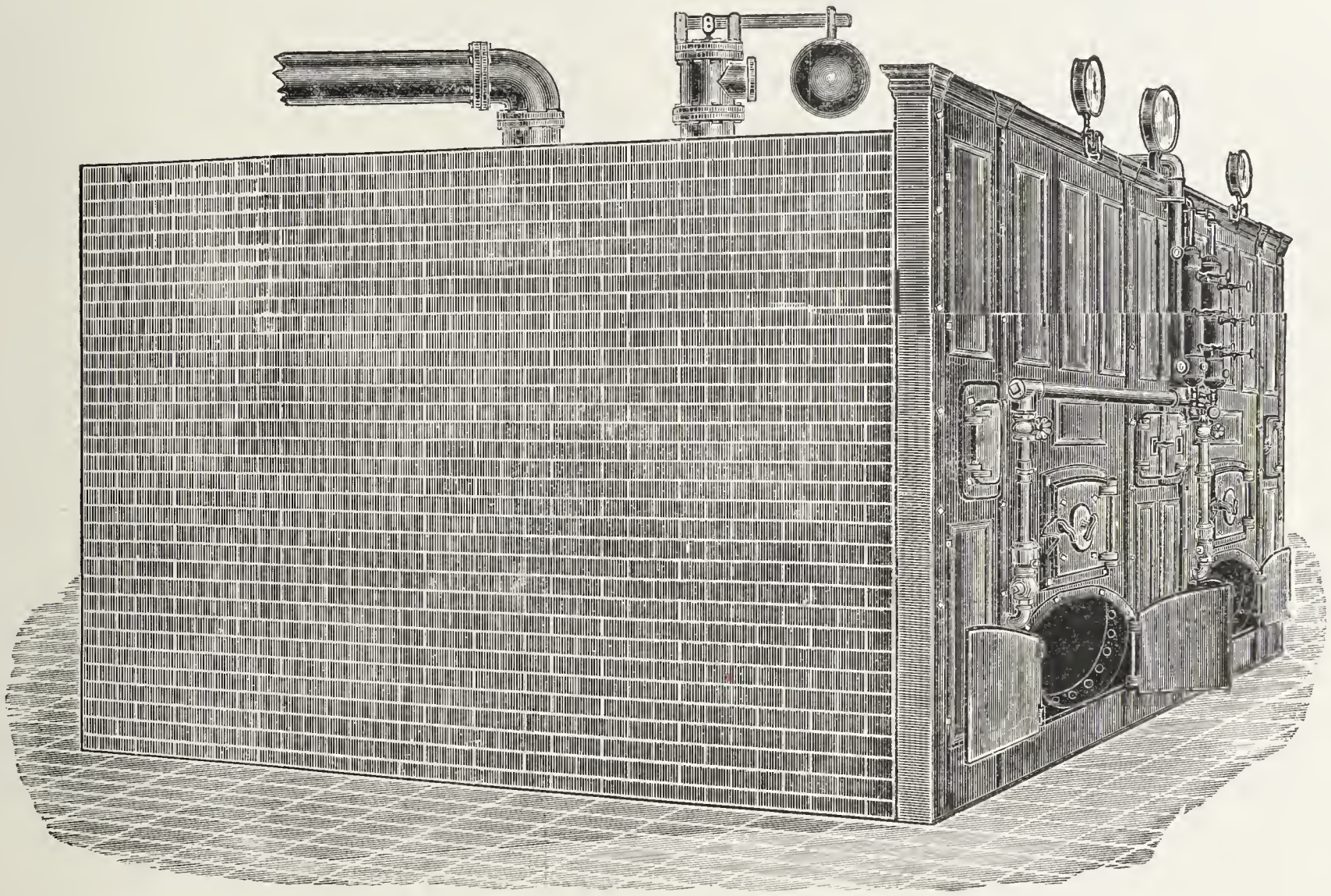


Kingsley Boiler Front End View of Naked Boiler ready for Water Test.

an ample combustion chamber, and are longer behind the bridge wall. Any tube can be readily screwed in or out of the crown sheet without touching any other tubes. The crown sheet is strongly stayed by stay-bolts, screwed simultaneously at various angles, into the semi-cylindrical top of the outer shell and into the crown sheet. These stay-bolts and those connecting the two shells are headed on each end. The parts of the two flanged heads forming the ends of the steam chamber are likewise stayed by rods screwed simultaneously into each, these rods being headed at each end or fitted with nuts.

The water is contained in the tubes, and in the space between the shells, and extends up a few inches over the crown sheet. As this water surface extends unbroken for the full length and width of the boiler, no rapid fluctuations of water level can take place, although the boiler is a very rapid steamer. It is possible to supply any capacity of water or steam space by extending the outer shell upward above the level of the crown sheet to any desired height. It is sometimes desirable to thus increase the steam space where large volumes of steam rapid currents when the boiler is under steam. After such investigations there can be no reasonable doubt on this point.

The reason for this exceptional cleanliness of the tubes is said by the makers to be clear when we consider the construction of the boiler. The feed-water, entering at the front of the boiler, between the shells, below the level of the grate-bars, in passing up becomes intensely heated before reaching the crown-sheet. It is well-known that water heated to a few degrees above the boiling point, parts with most of its impurities, as mud and carbonates of lime, and at a temperature of about 300 degrees Fahr., equal to 52 lbs. steam pressure, it can no longer retain in solution the sulphates of lime, magnesia, etc., which form the much-dreaded scale in boilers. In this boiler, these impurities being separated by the intense heat, precipitate into the space between the shells, at the bottom of the boiler, where the heat is not sufficient to bake them into scale, and whence they can be washed out occasionally through the hand holes. This boiler is, therefore, by its construction, stated to be a perfect feed-water purifier; and no sediment or



Kingsley Boiler—Representing Two Boilers of 150 H.P. each.

are required at one time, which occurs in various industries. No steam drum is used on these boilers. This is a great advantage over most water-tube boilers as well as many other types, as a steam drum elevated far above and away from the hottest fire can of itself act only as a condenser, as it is the tendency of steam to cool and condense immediately on leaving the direct action of the fire. In the Kingsley boiler the tubes, being vertical and short, liberate steam very freely, and without friction or impediment, which in all water-tube boilers with inclined tubes, causes a large percentage of water to be carried up with the steam. This is also one reason why this boiler produces dry steam even under the heaviest forcing. By those who have not investigated, an argument may be advanced regarding the deposit of sediment in the tubes. This, the manufacturers claim, may conclusively be answered by referring to boilers which have been in use for upwards of ten years. One of these in Chicago, being fed on the dirtiest of feed-water, has been in use for nine years. The users, a short time ago, wrote: "We have never had any trouble with the tubes filling with scale or sediment; but, on the contrary, we think they are brighter than new." Hundreds of tubes have been screwed out and examined for sediment, in various parts of boilers which have been running for different periods, and have been found perfectly clean; in fact, any scale formed in manufacturing the tubes appears to be loosened and removed by the ebullition and scale can gather in the drop-tubes, because only purified water reaches the crown-sheet, from which the tubes are supplied.

The boiler, being internally fired, has the fire-box entirely surrounded with a water-jacket. The incandescent gases from the fuel, passing up among the short tubes in the fire-box, are drawn backward among the long tubes to the end of the boiler, whence they divide and return, half on each side, between the outer shell and the brick casing toward the front of the boiler. From this point the now nearly exhausted gases can either be carried by means of a saddle over the front of the boiler direct to the chimney, or they can pass down into a flue under the boiler along to its back end, and thence to the chimney. There is no appreciable difference in economy of evaporation between these two methods of circulation of the gases. The tubes are "staggered" in the crown-sheet and are spaced at such distances that the gases which pass zig-zag and strike each tube at right angles, while being confined on all four sides by the water-jacketed shell of the boiler, lose nearly all their available heat before they are returned on the sides. For this reason this boiler can be operated also as a locomotive boiler. The gases are passed out of the chimney only sufficiently hot to insure a good draft. This boiler requires the same size of chimney as any other type of boiler. For hot-water heating for buildings there is no change in the construction of the boiler, the steam space being simply filled to the top with water. The fuel

economy is the same as for steam purposes. The circulation of the water is the most direct that can be desired, as there is a continual uninterrupted rise from bottom to top of the boiler. For marine purposes there is no change in the essential design of the boiler, the difference being in details and setting, as the brick casing could not be used. It has been installed for the highest pressures, and is as easily cleaned and as durable as any boiler made. The economy of installation is apparent when we note the claim that this boiler occupies one-third less ground area than the other ordinary types of horizontal water-tube boilers, or the return-tubular boilers, and less than one-half their cubic contents. It requires only 6½ feet in height. The brick casing is used only for the return gases, and hence never requires renewing. As there is no firebrick furnace to renew periodically, the repairs are reduced to an absolute minimum. It is not necessary to refer to the exceptionally high evaporative economy of this boiler, as this could be readily predicted from its construction.

## THE BARREN LANDS OF CANADA.

On a recent Saturday afternoon J. B. Tyrrell, of the Dominion Geological Survey, Ottawa, lectured to a very large audience in the Biological Department of Toronto University, Toronto, on the timely and interesting theme, "The Possible Resources of the Barren Lands of Canada." Introducing his subject, Mr. Tyrrell said that Canada was just now face to face with problems particularly her own. Reports of the fabulous wealth which reach us from the Yukon and elsewhere in the Dominion are naturally followed by the question: Are our young men being equally well trained for going out to the forest wilds to possess this wealth, as they are for other occupations in life? Continuing, Mr. Tyrrell deprecated the prevailing idea that a trifling knowledge of rocks and minerals is all that is necessary for the equipment mentally of young men going out to the gold and other mineral fields. Ignorance, he said, emphatically, means loss and failure in the locating of mines and minerals. Who would win in such search must be well trained. Only 10 per cent. of the great area of Canada is under cultivation at present; 35 per cent. only is capable of cultivation; there is a vast extent, roughly from about one to two million miles, which will not grow cereals, and which bears little or nothing. There are 750,000 square miles in which there are no fur-bearing animals, and which are rarely if ever visted by white men. These are known to the Indians as the Barren Lands. Of these there are 300,000 square miles in the Arctic Islands, 50,000 square miles in Northwestern Labrador, and 400,000 square miles west of Hudson Bay. Of these the lecturer said that he would consider the latter in his lecture, and try to show that there was every ground for hope that in the not far distant future Canada would have in these barren lands a sub-Arctic mining province, covered with comfortable homes, whose enormous wealth would in a great measure compensate the inhabitants for the rigor of the climate and other privations which are not known where nature is more kindly disposed. The barren lands of Northern Canada are three times as large as the British Isles, are bounded on the north by the Arctic Ocean and on the east by the west coast of Hudson Bay and Fox Channel. They are generally a vast undulating plain, broken by ridges, stony and bare, very flat for the most part, the grassy grounds covering a floor of soft creaceous shales and sandstones: a dreary, rocky, barren country. The highest point is reached in the Stony Mountains, which lie east of the Coppermine River, and are 1,500 feet above the sea level. The lecturer then went on to describe the inhabitants of these lands, who number 2,000 Esquimaux, whose pursuits are hunting and fishing, and 500 Chippewayan Indians, who retire to the forest for the winter. He described the animals, the principal of which is the Arctic caribou. Its flesh is excellent food for explorers and pioneers; it is here in countless numbers, and should it ever become extinct, it could be replaced by the Lapland reindeer. Other animals are the musk ox, which lives in the plains of the north; predatory animals are the white wolf, the wolverine, and the white bear. Whitefish and trout are plentiful in the rivers and lakes, and in the lecturer's expedition to these lands 124 specimens of plants were found. "But," said the lecturer, "it is to the mineral of these lands we must look for any real contribution to the national wealth." He then plunged into a very scientific description of the geology of the country, described the structure and nature of the rocks, showed that from Tobaunt Lake to Baker River there is a great extent of mineral-bearing rocks similar to the gold, silver and copper-bearing rocks on the north shore of Lake Superior, and in the Lake of the Woods district; he said that copper-bearing rocks extend along the Arctic boundary, and that there was every evidence to show that similar conditions existed in the numerous adjacent islands; indeed, there were many thousand square miles of these lands plentiful in copper; so plentiful were the evidences of this mineral that the lecturer thought that the barren lands will be as productive as Michigan. Besides copper and lead, gold, silver and nickel are there, with iron in enormous quantities; in brief, the lecturer had collected abundant evidence to show that there is a great natural wealth in the barren lands of Canada, which can now be reached with little trouble and expense. Ocean steamers can sail to the head of Chesterfield Inlet, which is open three months of the year; south of Chesterfield Inlet are good harbors, from which the Huronian rocks may be explored. Still further south, Fort Churchill is an excellent land-locked harbor, open for five months of the year, from June till November. The Hudson Bay steamer runs from London to the harbor. In every way Mr. Tyrrell thought that these lands were worthy of exploration and settlement; they are easily accessible, and the climate is not too rigorous in winter; and that their vast wealth now locked up will yield splendidly to work and enterprise.

Mr. Tyrrell's lecture was well illustrated by photographs, which were taken during his expeditions to the barren lands. When thrown upon the screen they gave a very good idea of the nature of this country, its inhabitants, animals, lakes and rivers.

## MECHANICAL DRAWING TOOLS.*

By S. J. Ireland, Principal of Hamilton Art School.

Many parents have the mistaken idea that by getting a cheap set of drawing tools for a boy as a present they are creating in him an incentive to the study of art. A cheap case of instruments has been the means of spoiling many a boy's ardor for drawing. I have before me two cases of drawing instruments. One of these cases costs but $1.50; the instruments in this case have their points rounded, and their joints can be opened to permit cleaning. For a cheap case this is very good. The other case costs from eight to ten dollars, but as far as the merits of the instruments are concerned, I would rather have the first. Everyone knows what a pair of compasses is and what used for. The cheapest kind have brass cheeks and heads, but it is a well-known fact that brass rubbing on brass causes too much friction. Another kind has double cheeks, and is known as the hair divider. Most compasses are of English make, and these instruments appear to be made to last forever. The instruments made by the Germans, with exception of those made by one firm, are practically useless. But this one firm which is the exception makes the best instruments in the world. The best English compass is known as the Sexton joint. Compared with the German, the English compass is heavy and lob-sided, while the German instrument is finely balanced, easier to handle, and is superior to the English compass in the joint.

Pencil drawings must be inked in. Pens form one of the chief features of the draughtsman's outfit. A pen with both points bent inward should be thrown aside. The screw must not be so near the handle as to leave the ends too long. If overcharged with ink, a pen of this kind is apt to blot. The German pen has short ends and a registered screw. The time saved by the use of this pen is considerable. I have here a pen by the use of which circles and curves can be made without the aid of a ruler. For the finest work a spring point is used. This instrument has not been improved on in the last forty years. The Germans produce a very fine instrument of this kind with which you can take a measurement to the three-hundredth part of an inch. The cost of this instrument is $4.85. The German rotating compass has never been successfully imitated by the English or Americans. An instrument is now made for making dotted lines; it does fine, regular work, and is the means of saving considerable time. For making larger circles a longer radius is required. In the old English beam the pencil point and the point on which the pencil rotates are both of the same length, while the German beam has the advantage of having the pencil point shorter than the other by.

*A Paper read before the Hamilton Branch, C.A.S.E.

the thickness of the drawing board. A dotting machine is also made to be used in connection with the beam. Protractors are used when the drawing is so fine as to be measured by degrees, minutes and seconds. All lines drawn on a level surface should be done with the aid of a "T" square. The best kind of these squares are those having an inclined edge. The best set squares are made of hard rubber. The slide rule is of great importance to every class of the community, but very few know how to use it. There is no arithmetical calculation known that cannot be solved by the use of this instrument. More can be done in five minutes with this rule than can be done in five hours or five days by arithmetic and algebra. A book on the use of the slide rule, written by Riddell, may be found in the Public Library in Hamilton.

## THE FEDERATED CANADIAN MINING INSTITUTE.

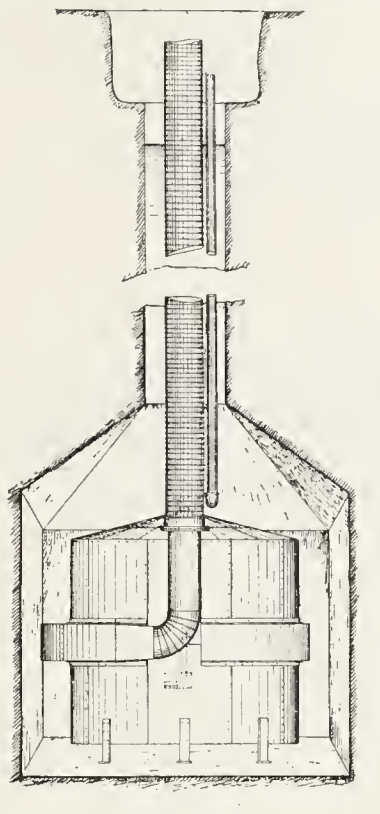
The second conference of the Institute opened in Montreal on March 2nd. As the meeting was held so near our date of publication, we are unable to give a full report of the proceedings. Considerable discussion took place on the effort made by the Canadian Society of Civil Engineers to become members of that association before practising in Canada. The Institute was resolved into the Canadian Institute of Mining and Metallurgy, a constitution being adopted. The Institution passed a resolution condemning the export duty on nickel mat. J. E. Preston, McGill University, read a paper on "Notes on the Ventilation of a Deep Metal Mine as Affected by Seasonal Changes of Temperature," at the evening session. This was followed by "Cableways as Applied to Open Pit Mining," by Spencer Miller, C.E. F. T. Snyder read a paper on "Some Modern Forms of Milling Machinery," and John Birkinbine, Philadelphia, one on "Commercial Progress as Influenced by the Development of the Iron Industry." Hamilton Merritt's paper treated of the gold-bearing reefs and placers of Northern British Columbia, and W. L. Goodwin read some Notes on the Anaylsis of a Rare Mineral. The following officers were elected: President, J. A. Hardman; Vice-presidents, W. A. Carlyle, Victoria; Charles Fergie, M. E. Westville, Nova Scotia; John Blue, and Dr. G. M. Dawson, F.R.S.; members of the council: Nova Scotia, Henry S. Poole, Stellarton; Major L. G. Leckie, Clarence Dimmock, W. L. Libbey, British Columbia; J. P. Hobson, Canal Forks; F. C. Loring, Rossland; W. Blackmore, Coal Creek; and R. G. McConnell, at present of the Geological Survey. Ontario, Archibald Blue, James McArthur, Sudbury; F. T. Snyder, Keewatin; H. Merritt, Toronto. Quebec, G. F. Drummond, G. R. Smith; Penhill, J. Obalski, M.E., Inspector of Mines, Quebec; Treasurer, A. W. Stevenson, Montreal; Secretary, B. T. A. Bell.

—F. J. Appleby, C.E., and J. J. Wilde have commenced business under the firm name of Appleby & Co., Room 501, Board of Trade Building, Montreal, as manufacturers' agents for bridge work, metals and rubber, mining machinery, tools, etc.

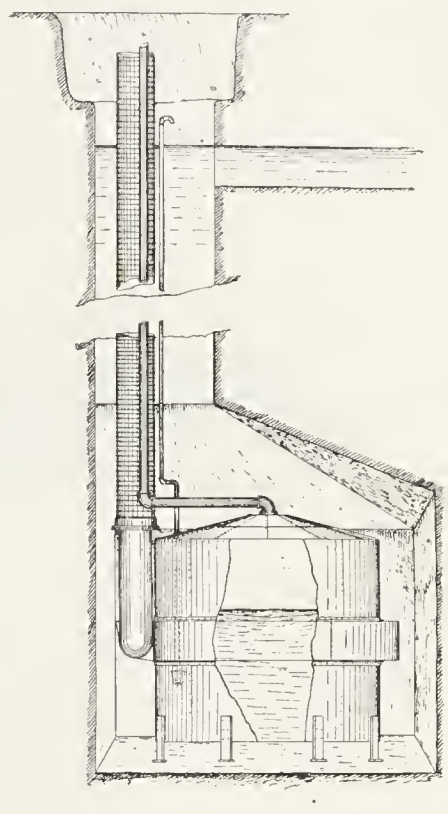
## THE KOOTENAI AIR SUPPLY COMPANY.

The compressed air plant under the Taylor Hydraulic Air System, which is now being installed at the camp of Ainsworth, B.C , by the Kootenai Air Supply Co., is of such general interest to the mining world that a detailed sketch of the plant will be of interest to the numerous readers of The Canadian Engineer.

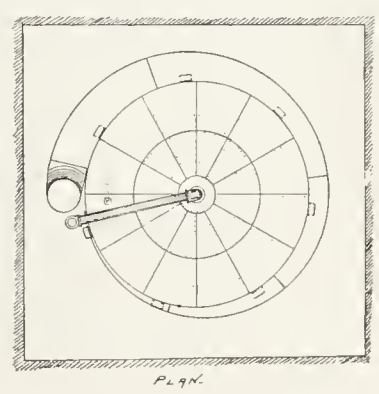
Ainsworth is the oldest working camp in West Kootenai. The ores are silver-lead in a very heavy formation, where the cost of development is quite high, and requires considerable power. The veins carry considerable water, and so far no great depth has been attained on any of the properties. There are several shipping mines in the district, and two concentrators. The point at which the Kootenai Air Supply Co. is installing its plant is on Coffee Creek, about two miles south of the heart of the district. The creek rises 25 miles back from Kootenay Lake in the high altitudes of the Slocan Mountains, and the stream is fed by a huge glacier. Like all mountain streams, the flowage varies abnormally, the lowest reading being about 2,500 cubic feet to a maximum of 8,000 or 10,000 cubic feet per minute. The high water period extends through the summer months, and until late in the fall, or during the period when a greater demand occurs for air. The creek has an average fall of 10 feet in 100, and the company is now building a dam across this creek five feet high, and a circular stave barrel flume, which has been sawed by the Salmo Lumber Co., the staves being 3 inches by 4⅛ inches, bevelled to the shape of a barrel five-eighths-inch round; iron bands, with take-up bolts will be used to hold the flume together, and these will be set every three or four feet on the flume. Joints are broken alternately in the wooden stave, a saw cut being made at the end of each stave, one-eighth inch thick and one inch deep, and a piece of iron of the same size is inserted to join the staves together. The lumber used is cedar, and the flume will be set on ties and wedged in place. This form of construction is quite common on the coast, and a flume of the character in question will last longer than a light hydraulic iron flume, the lumber becoming water-soaked and practically imperishable. The total length of the flume is 1,354 feet, and the pressure on the flume will vary from 5 to 10 lbs., dependent on the height of the stream. This flume will cost complete with iron rods, exclusive of grading, about $1.25 per foot. The lumber is laid down dressed at $11.50 per M., lumber being exceedingly cheap in this section, while iron, owing to excessive freight rates, is very high.



End Elevation.



Side Elevation.



Plan.

Taylor Hydraulic Air Compressor.
for
Kootenay Air Supply Co
Coffee Creek, Ainsworth District, B.C.
Scale ½" = 1 Foot.

The company is proposing to instal the receiving water tank and the down-flow pipe in wood, stave barrel construction being used throughout, so that the only iron in the plant will be the air chamber at the bottom of the shaft, and the ⅝-inch iron rods necessary to hold the flume and the down-flow pipe.

The head under which the plant will operate is 107 feet from the level of the water in the tank to the level of the water in the creek, and the back pressure of the rising water in the shaft will equalize the pressure in the down-flow pipe, so that the severest pressure at any point on the down-flow pipe will not exceed 60 lbs. The hoops will be put on at distances varying from 6 inches to 3 feet. The total depth of the shaft, which is now down about 90 feet, will be 210 feet, of which 20 feet at the base will be for the compression tank. In order to overcome the loss in the Magog plant due to ineffective separation, some slight modifications will be made in the construction of the Ainsworth plant, as will appear from the detail annexed. The down-flow pipe discharges its water into an iron inlet, which extends itself all round the centre or water line of the compression tank, and as the circumference of this tank will be approximately 51 inches, and the water with its corkscrew motion and its high velocity swings around this inlet, every particle of air carried down will be separated, so that the company's engineers figure on an efficiency of at least 70 per cent. of air h.-p. out of the gross h.-p. of the stream.

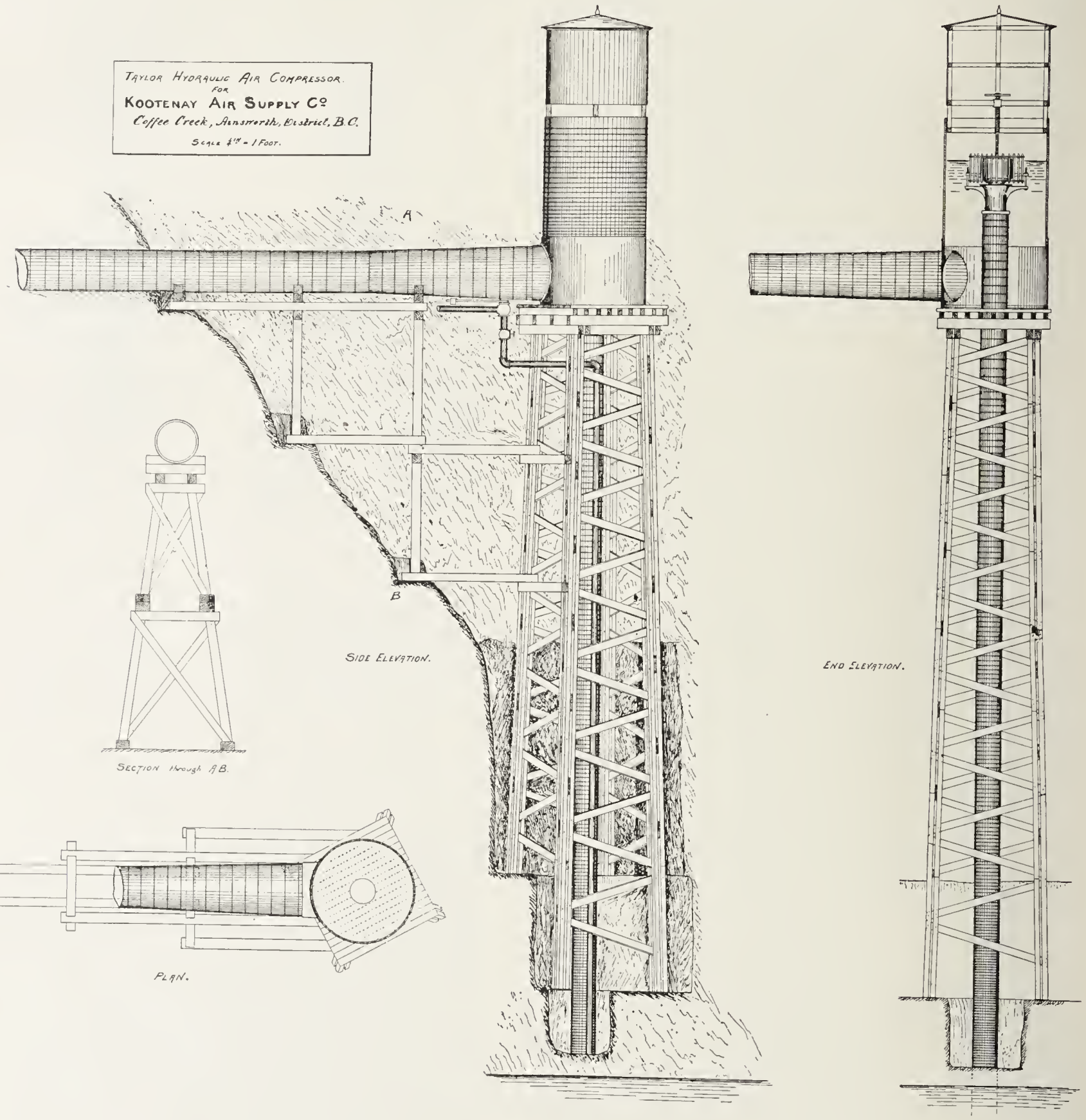
By the substitution of wood for iron in this work, the cost of the installation will be a moderate factor, and when the compressor outputs 500 air h.-p. the h.-p. cost of the air at the compressor site will represent a capital investment of only from $22 to $23. The h.-p. output of the compressor will vary from 340 h.-p., when the flowage is

2,500 c.f. per minute to a maximum of 650 h.-p. when the flowage is 4,500 c.f. per minute, the details of the plant being all worked out for the maximum flowage, which could be maintained throughout the entire year, if necessary, by the construction of further dam accommodation to store the water for the heavy load.

The company is now working 20 men sinking the shaft. The shaft is 6 x 8 feet in area, and a small boiler, 6 x 8 double hoist, and No. 2 Rand drill—all supplied by the Jenckes Machine Company—are now running on the work. The shaft is being sunk alongside the creek, and up to the present time, on account of the hardness of the rock, very little water has been met. Progress at the rate of about a foot per diem in sinking is attained, the cost being between $25 and $30.

Co. expect to sell power for the air drill on the 24-hour run at $3 per day, or less than the price of a miner's wage, and the mine owner will be saved all the capital cost of installing a compressor, with its attendant worry and cost of operation. Any prospector along the line of the pipe-line can tap on with a small pipe, and run a drill or a hoist, the capital cost of which is not very great, and when he is through with his work upon any particular property he can take up his outfit and move it to another claim. The power company, while able and ready to cut existing rates in two, will still make handsome profits, for with a drill rate of $3 (less than half the price of a miner's wage on the 24-hour run) the air h.-p. will still net, if from 20 to 30 drills are connected, between $140 and $150 per h.-p. per annum.

The estimated cost of the pipe lines laid on the ground is $18,000,




The main pipe-line of the company will be run from the compressor to some point on the "Black Diamond" ground, a distance of 10,000 feet. This pipe-line will be 9 inches in diameter in the clear, and with an initial pressure of 90 lbs., and allowing a loss of 10 lbs. in transmission, will discharge 4,600 c.f. of free air per minute, or, with 5 lbs. loss, giving a final gauge pressure of 85 lbs., will discharge 3,000 c.f. of free air per minute. From the "Black Diamond" ground branch pipe-lines will reach out to the principal operating properties in the district, and it is expected that with two miles of these branch pipe lines, varying in size from 3 to 6 inches, from 250 to 350 h.-p. of air can be sold. The pipe-lines will be of wrought iron, with bolted joints and rubber gaskets.

Throughout the Kootenay district the present charge for the air drill, consuming from 80 to 120 c.f. of free air per minute, varies from $5 to $7.50 per day, dependent upon the size of the steam compressor plant and the fuel conditions prevailing. The Kootenay Air Supply

a portion of which, however, will be borne by the consumer, bringing the total estimated cost of the plant to $30,000. When once installed, the maintenance and operating expenses should be inappreciable. There is no moving machinery to wear out, no operators needed at the central station, and the life of the pipe-line is almost perpetual, as being laid above ground, it is affected only by atmospheric conditions.

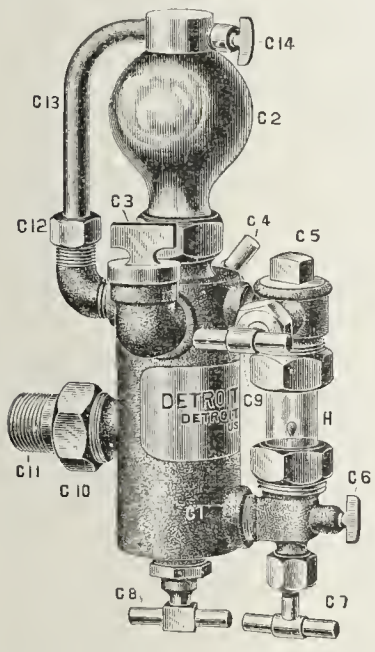
The greatest interest is being taken by miners, who are the largest users of air in the world, in this installation at Ainsworth. It means a vast saving in mining, for there are few mining districts throughout the entire West where a sufficient amount of water power is not available within from five to ten miles of mines to operate plants, and after the capital investment has been made the miner practically gets his motive power (and air is absolutely essential to him as motive power) without any cost other than the interest charge.

Steps are now being taken by the Taylor Air-Compressing Co., which is installing the plant at Ainsworth through its sub-company,

the Kootenay Air Supply Co., to make a similar installation in the Rossland and Ymir districts. In the former district some 750 actual air h.-p. are to-day being consumed, and the total cost of the air h.-p. at the mine to-day averages more than $200 per air h.-p. per annum. This section is one of the most inviting fields for the installation of a plant, the rock being especially hard, and the air power being absolutely indispensable for mining in the district.

## A COLD WEATHER LUBRICATOR.

In the Northern States and Canada, where the winters are severe and of considerable length, it is often a difficult matter to maintain a steady feed of oil to the cylinders of engines. This is particularly true in the case of many mills and other steam plants where the engine room is exposed more or less to the cold. The oil thickens into a viscous, jelly-like mass, which will not break up into drops nor feed through the ordinary lubricator. As a result, the valves become cut and worn, and there is a double waste of energy due both to the cold and to the friction. Recently an ingenious lubricator has been designed by the Detroit Lubricator Co., of Detroit, Mich., to overcome these conditions. It is very appropriately called the "Zero," and is shown in the accompanying cut. Right above the support arm, inside the outer shell, is a heating chamber, which is always filled with steam while the engine is working. This steam heats the oil, and keeps it warm and in a liquid state, no matter how cold the weather. Of course, in very cold weather, it will use up some steam to keep the oil heated, just as it does to keep the cylinder heated, but the heat in the one case is just as positive as in the other. This heating chamber is perfectly automatic. In cold weather the steam in this heating chamber condenses more or less, and the condensed water runs back into the steam-pipe, keeping the chamber always filled with steam. These "Zero" cups have been on the market for nearly two years. They have been adopted by almost every American builder of threshing engines and by several Canadian ones. They are also used very generally on stationary engines that have to work in cold locations. Any one interested can obtain a descriptive circular or a complete catalogue showing them by dropping a card to the manufacturers.



ZERO LUBRICATOR.

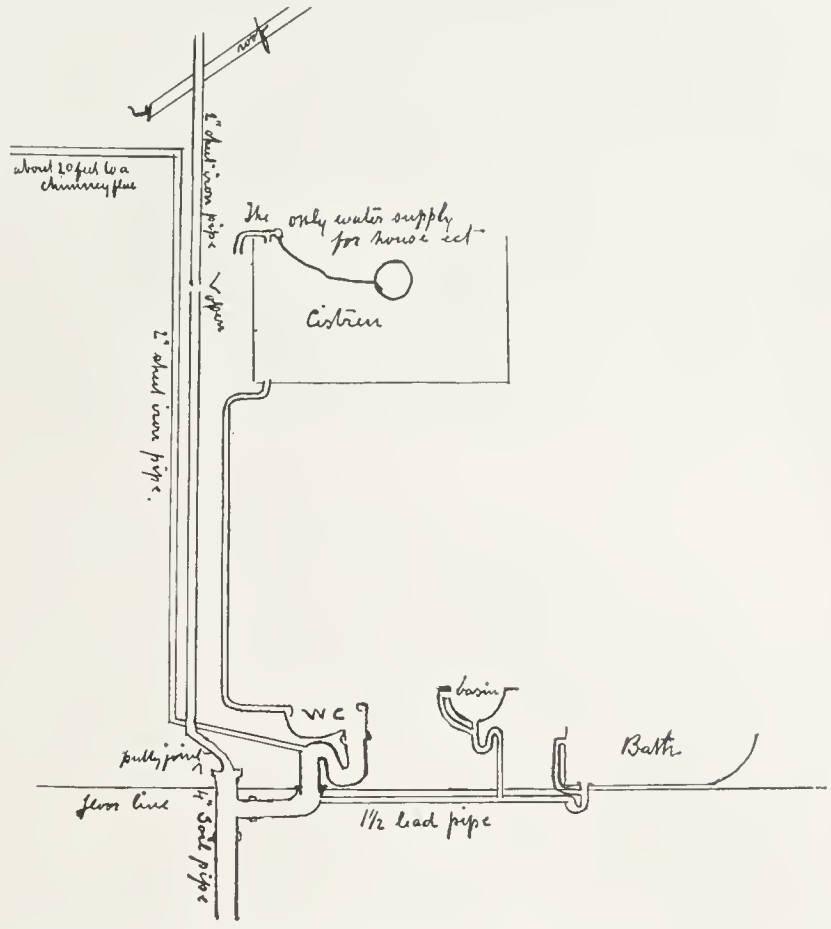
## DANGEROUS PLUMBING.

*Editor* THE CANADIAN ENGINEER.

SIR,—In one of Toronto's large, well-appointed and handsomely furnished residences, a licensed plumber was engaged to remove an old pan water-closet, and the lead bend and P.-trap, and fix in a 4-inch by 4-inch tee in place of the lead quarter bend, and a 4-inch lead bend in place of the P.-trap, and an improved sanitary two-piece water-closet in place of the old pan water-closet.

The house had been fitted up in the first place in the old English style, having a large lead-lined storage cistern, from which the w.c. was flushed, and the range boiler and every water tap in the house was supplied. The cistern itself receiving its water through a ball tap and lead pipe direct from the city water mains. The old pan was vented by the 2-inch horn upward through the roof by a 2-inch sheet-iron pipe that dropped in two when the old closet was removed at the point shown in the sketch between the cistern and a wall having a space of about six inches jammed with about six different lines of pipes.

From the socket of the 4-inch to 4-inch soil pipe tee, the plumber fixed a 2-inch piece of sheet iron pipe up to within 1½ inches of the end of the old pan w.c. vent pipe at the end of cistern (see sketch), and there left it as a completed job, because one end was vertically under the other. By this, most of the sewer gas that should pass out through the roof is abstracted and absorbed by the drinking water stored in the cistern close by, which would partly poison the water and make it unfit to use for domestic purposes. And if not all absorbed by the cistern water, the balance would pass into the room, little if any would pass up the pipe except when the temperature of the room was lower than the outside. From the vent-horn of the new sanitary trap, he took another two-inch sheet iron pipe up and over the ceiling of room for twenty feet perfectly level to a chimney. He could have graded upward to a higher level of 8 feet if he chose. To expect air to circulate through so long and small a pipe laid level is absurd, and if it did deliver the sewer gas in the chimney at the point about 12 feet below the discharge head, it would not ascend upward except when the flue was warm. When no fire was burning and the flue was cold the sewer gas would descend the straight flue into the living apartments.




The third error is seen by referring to the sketch at the point where the 1½-inch bath waste joins the heel of 4-inch lead bend. When bath pipes are joined in this way the excrement is liable when it bounces on the heel of bend to rebound back up the 1½-inch pipe, and charge the pipe, beside pressing the foul air in the small pipe through the water seals and by the act of making the water seal to oscillate to break the seal of the trap and leave it open until more water is run in.

This job has only been done within a few weeks time and one would hardly have expected to find such dangerous ignorance displayed, especially in a house where the total cost of good sanitary arrangements and workmanship would probably be only one-tenth of the amount of the house furnishing.

WM. WATSON.

567 King st. W., Toronto, Feb. 15th, 1898.

## METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during January, 1896, 1897.

| | January. 1896. | January, 1897. |
|---|---|---|
| Hardware and cutlery | 4,765 | 1,636 |
| Pig iron | 380 | 504 |
| Bar, etc. | 1,236 | 285 |
| Railroad | .. | 50 |
| Hoops, sheets, etc. | 1,840 | 827 |
| Galvanized sheets | 654 | 2,031 |
| Tin plates | 22,508 | 11,929 |
| Cast, wrought, etc., iron | 1,684 | 1,874 |
| Old (for remanufacture) | 191 | .. |
| Steel | 2,586 | 4,521 |
| Lead | 519 | 978 |
| Tin, unwrought | 3,046 | 422 |
| Cement | 468 | 518 |

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

KINGSTON NO. 10.

A special meeting of Kingston No. 10 Canadian Association of Stationary Engineers was held in Congress Hall, January 26th, 1898. It was called for the purpose of visiting the members of Parliament, B. M. Britton for the city and David Rogers for the county, *re* legislation. The following members of the association were present: President Simmons, Vice-President Asselstine, Past President Donnelly, Bros. Hoppins, Blomely, Woodrow, Davis, Taudrein, Linton, Strong, Gascoyne, Selley, Derig, Bajus, Turnbull, sr., Tait and Orr. There were also present certificated members of the Ontario Association: David Leslie, P. McArdle, James Ross and George Hazlett, of the Winnipeg branch of the association. All of the above members formed a deputation and proceeded to B. M. Britton's office; when David Rogers arrived the business was proceeded with, President Simmons reading and presenting an address, along with a copy of the Act, to Mr. Britton, after which H. Hoppins, in a few well chosen remarks, pre-

sented a copy of the address and the Act to David Rogers. Both gentlemen replied. After a few questions were asked regarding the working of the association, which were answered satisfactorily by President Simmons, Past President Donnelly, Bros. Hoppins and Blomely, the question was put to Mr. Britton if he would support the bill. He stated he would, and more than that, if the party having the bill in charge wanted any help to get it in shape to go before the House, he would only be too happy to give him any help he could to make it a success. Mr. Rogers was then asked if he could support it. He said he could not see anything in the bill but what was right and just, but he would not pledge himself until he made further enquiries. The deputation retired, feeling satisfied that when it came before the House he would support it. At a regular meeting held on the 3rd February, there was a resolution made that a hearty vote of thanks be tendered to B. M. Britton and David Rogers for the reception they gave the deputation of engineers who waited on them, and also that a copy of the minutes of the special meeting be sent to THE CANADIAN ENGINEER for publication.

JOHN L. ORR, Sec.,
Kingston No. 10, C.A.S.E.

C.A.S.E., TORONTO, NO. 1.

C.A.S.E., Toronto, No. 1 held its regular meeting on Feb. 2nd. There was a good attendance and two initiations, and two propositions were received. There were several questions in the question box. Bro. Miln took them up and figured them out on an old door, the new blackboard not being finished. Bro. Miln also took up the question, "What Makes a Motor Go?" and his explanation was highly appreciated by all the brethren present.

Their regular meeting on Feb. 16th, was held in their hall, 61 Victoria Street. There was a fair attendance, and after the regular business was over, and the question box opened, it was found to be full of Scranton School questions, some of which were answered and some taken home by the brethren, to ponder over till the next meeting night, when they will be expected to work them out on the new blackboard.

At the regular second Tuesday evening open meeting, Feb. 15th, Bro. Wickens continued his talk on The Steam Engine Indicator, after which a hearty vote of thanks was tendered to Bro. Wickens.

At the regular meeting on March 2nd, Engineers' Hall, 61 Victoria street, there was a good attendance and one candidate was initiated. A number of questions were asked and figured on the blackboard by Bros. Past Presidents Fox, Moseley and Bannan, which work was greatly appreciated by the brethren present. A Legislative Committee reported that all the members of the Dominion Government present in Toronto had been written to, asking their support for the Engineers' License Law and Boiler Inspectors' Act, which is to come up at the present session, and a number of them have promised their consent.

The regular open meeting will be held Tuesday evening, 8th inst. Mr. St. John has kindly consented to give a talk on the strength of boilers. The president expects a large attendance, and invites all engineers to the open meeting. The members "do not want to keep all the good things to themselves."

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—The annual meeting of the Canadian Press Association will be held in Ottawa, 10th and 11th inst. Among the important matters to be considered will be the postage question, insolvency legislation, and the visit of British journalists to Canada. Frank A. Munsey, who has been without doubt the most successful modern publisher, will deliver an address on and discuss the "Elements of Success in Newspaper Publishing." It is hoped that one or two of the following representatives of the British Institute of Journalists will be present: Lord Glenesk (London *Morning Post*), Sir Hugh G. Reid, M.P., J. M. Maclean, M.P., and Sir Edward Russell. The dinner will take place as usual, when a number of important speeches will be made.

—P. B. OWENS writes to a contemporary:—"In these days of enormous productions of iron and of stupendous commercial transactions, it no doubt will interest many of the present generation to learn that mining, smelting and manufacturing of iron was an established industry in the County of Essex, Ontario (then Upper Canada), in the early part of this century. A smelting furnace was built in the Township of Gosfield, on the farm of Michael Fox, about one mile north of where the Olinda post-office now stands. The ore was taken from natural deposits in the adjoining Township of Mersey, and the fuel used was charcoal produced in the immediate vicinity. The writer remembers how wonderful the furnace, the smoking stacks of wood covered with earth, and the sluice boxes for the washing of the ore all appeared to his childish mind. A large quantity of timber was consumed in the production of the charcoal, timber which, if now standing, would be of enormous value. But no kind of timber, except white oak, was then considered of any value, even black walnut being made into fence rails, and much of it actually burned up in clearing the land."

—The German Association for Acetylene and Calcium Carbide will hold an exhibition of the recent progress that has been made in this industry, and at the same time a congress to consider the various scientific and practical questions that have arisen in connection with it. The exhibition, which will be held in Berlin from March 6th to March 20th, will comprise acetylene generators, lamps, purifiers and mixing apparatus, acetylene burners, motors and soldering tools, calcium carbides, electric furnaces and electrodes, and the different varieties of machinery used in the manufacture of the calcium carbide. Rigorous regulations have been adopted by the Berlin police to prevent any premature explosions, and no generating apparatus using more than about one-half pound of the calcium carbide will be permitted in the main exhibition hall. The use of pure, compressed, or liquefied acetylene gas will be prohibited, and a limit of a hundred and twenty pounds pressure has been placed on mixtures of the gas. The use of acetylene gas for illumination is increasing, and the coming exhibition will show how general its application can be made, as well as the simplicity with which the gas is generated.

# Industrial Notes.

THE St. Thomas, Ont., city council is looking for plans for the new city hall.

GEO. GRANT, Arnprior, Ont., has the contract for building a bridge at Burnstown, Ont.

CHAS. RITZ has bought the foundry until lately run by C. Ritz & Co.—*New Hamburg Independent.*

THE Grand Trunk Railway, it is stated, contemplate building a mammoth hotel in Quebec city.

D. RICHARDS & Co. speak of the erection of a steel and brick addition, 90 x 40 ft., to their soap factory at Woodstock, Ont.

A BY-LAW, under which Goderich, Ont., is taking $50,000 stock in the Elevator Company, has been carried by 416 majority.

J. WILSON, foundryman, St. Catharines, Ont., has received a large order for wire cables for mining in British Columbia.

THE Stellarton, N.S., Lubricating Company, we understand, intends shortly to commence the manufacture of their lubricant on a large scale.

J. R. ADAMSON, Cornwall, Ont., is one of the incorporators of the Black River Creamery Co., Limited, which intends building a factory at once. Capital, $2,000.

APPLICATION has been made for the incorporation of a company to be known as the Woodstock, N.B., Sash Balance and Lock Company, to manufacture and sell a patented window raising and locking contrivance.

THE residents of North Cypress, Man., are endeavoring to make arrangement for a bonus of $10,000 to a flour mill and elevator. The mill is to have a capacity of 300 barrels and the elevator 100,000 bushels capacity.

THE new agricultural hall at Shawville, Que., will cost about $3,000. The design has been made by architect Edey of Ottawa, and is for a building of octagonal shape, the dimensions being 99 feet diameter, and a 27-foot wall.

THE Knowles Bicycle Company, Limited., is applying for incorporation; chief place of business, Brantford, Ont.; capital, $50,000. The provisional directors are: W. J. Knowles, W. G. Nott, J. T. Ham, J. H. Ham, and Maria Knowles, Brantford.

A DOMINION charter has been granted to C. Guimond, Beauharnois, Que.; C. F. Lalonde, Montreal; J. Leduc, Beauharnois; J. B. Roy, Beauharnois; Delia Rochette, wife of Emilien A. Manny, Beauharnois, as the Star Iron Company, Limited, with a capital of $60,000.

FRED. H. DOUGHTY, formerly in the employ of Jas. McPherson & Co., Hamilton, Ont., has purchased the business of H. B. Livingston & Son, machinery agents, Leicester, Eng., and, with Mr. Livingston, jun., will continue the business under the firm name of Livingston & Doughty.

A PLEASANT event took place at the B. Greening Wire Company's works, Hamilton, Ont, on a recent evening, when the employees of the rope department presented the foreman, Charles A. Herald, with a set of drawing instruments. Louis Beck made the presentation, with a felicitous speech. Mr. Herald made a suitable reply, thanking his co-workers for the pleasant surprise.

W. BURROW, C. Stewart, J. Milne, J. Stewart and C. Milne, Hamilton, Ont., and W. Burrow, jr., Chicago, Ill., are applying for a Dominion charter as the Burrow, Stewart & Milne Company, Limited, to manufacture stoves, furnaces, scales and hardware generally. Chief place of business Hamilton, Ont.; capital, $250,000.

LONDON, Ont., wants an engine to run its stone crusher.

ST. CHARLES COLLEGE, Sherbrooke, Que., is to have a new building.

A ONE hundred thousand dollar block of buildings is to be erected at Victoria, B.C., by the Molsons Bank.

DESERONTO will vote on a $20,000 bonus towards a charcoal iron smelting works in that town, to cost $250,000.

PETER STEWART, Arnprior, Ont., has secured a position with the Wm. Hamilton Manufacturing Co., Peterboro, Ont.

THE contract for building the Simcoe county, Ont., House of Refuge has been awarded to A. Tessier, Penetanguishene, for $14,966.

THE New Brunswick Government has invited tenders for the extension of the breakwater at Centreville, N.B., estimated to cost $4,000.

THE Carleton Place, Ont., council has had a letter from the Perth Waterworks Co., Limited, asking for a similar franchise from that town as they received from Perth, Ont.

THE Lancaster Machine Works, Lancaster, Ont., are kept busy with orders in all lines, especially in their line of cotton mill machinery, in which they are building up a good trade.

A NEW single span iron bridge will be placed over the River Raisin, at South Lancaster, Ont., the coming spring, to replace the old wooden structure, which has been condemned.

THE London, Ont., Foundry Company has received orders for four carloads of wheelbarrows, forges and miners' tools, for shipment to the Klondyke. The order comes from a Vancouver firm.

THERE is every indication of a good dairy season during 1898, and manufacturers are preparing for it; already the Lancaster Machine Works have booked several orders for their patented specialties.

THE Nelson, (B.C.), Iron Works are employing 12 men at present. They make and repair machinery for the mines in the vicinity. They recently completed a contract for water hydrants for Grand Forks.

WE have received from the International Correspondence School, Scranton, Pa., a booklet containing some hundred testimonials from pupils all over the world, who have studied under its direction with much benefit.

THE Massalon Paving Brick Company, of Massalon, Ohio, is endeavoring to place its wares on the Canadian market. The Massalon brick is larger than any of Canadian manufacture, and is said to be one of the best made.

G. H. MCGILLIVRAY, township clerk, will receive tenders up to noon on the 19th inst. for the construction of two stone abutments on the site of the Lancaster bridge, South Lancaster. Tenders will also be received for concrete abutments.

THE stock and plant of the Beaver File Works, Levis, Que., was sold by auction a short time ago. The purchasers were Marcau & Jauteau, who have now decided to change the name, and in future the concern will be known as the Mechanics' Star File Manufacturing Co.

THE Moore & White Co., of Philadelphia, manufacturers of clutch pulleys, couplings, etc., have appointed the Lancaster Machine Works, of Lancaster, Ont., as their representatives in Canada, from whom all particulars regarding these justly celebrated friction driving devices may be obtained.

THE Hamilton, Ont., municipal estimates for 1898 contain the following large items, among others: Catharine street sewer, $22,000; Wood street (John to James) sewer, $3,700; trunk sewer, east end annex, $20,000; Aberdeen avenue sewer (Locke and Garthe) $3,900; disposal works, expense, $10,000; gully drains and ventilators, $2,500; Mountain drain improvements, $2,500.

THE Ingersoll-Sergeant Drill Company has issued a very neat booklet, which is practically a condensed edition of their catalogue of air compressors, It contains illustrations of the various types of compressors, and shows some of the uses they may be put to. Copies of this handy little volume may be had by applying by postal card to the Montreal office, 299 St. James street.

G. W. RICHARDSON, representing the proposed Rossland, B.C., Gas Company, asks the following concessions from the municipality: The right to construct and operate gas works and to supply gas to the citizens of Rossland for ten years, with the right to lay mains and service pipes along the streets of the city; gas to be of a standard not less than 16-candle power, and to be supplied at a rate not more than $2.50 per thousand feet; work to commence in six months and to be completed within two years; gas to be supplied to the city at $3 per month per light, if 25 lights are taken, and $2.50 per lamp if more than 30 lamps are used; corporation to have the privilege of purchasing the plant at any time within ten years at a price to be decided by arbitration.

J. HANBURY, Brandon, Man., is negotiating with the municipality to start a wood-working factory. The proposed building is to cost $20,000.

W. PERRY, representing the R. H. Buchanan Co., engineers, Montreal, in connection with the Rider Ericsson Hot Air Pumping Engine Company, recently, at their works, Walden, N.Y., made a test of the new improvements on the hot air pumping engines, which far exceeded any previous tests, and was in all details satisfactory. The severest tests were applied.

THE Willson Carbide Works, Merritton, Ont., have been so crowded with orders that they decided to start their works on Sunday; that is, instead of closing at 12 o'clock Saturday night and remaining closed until 12 o'clock Sunday night, they now run until 7 o'clock on Sunday morning, and remain closed until 5 o'clock Sunday afternoon. To these arrangements the Lord's Day Alliance took exception, and caused fourteen of the employees to be summoned before the police magistrate.

THE Hamilton, Ont., papers reported that Engineer Barrow had made a test, for capacity, of the pumps and machinery at the sewage disposal works. The showing made was 3,175 000 gallons in 24 hours, which is 175,000 gallons above the requirements. This work was done with one engine only in operation. Mr. Barrow expects to be able to bring about a great saving in chemicals, not only by a change in the precipitants used, but also through the large settling surface. At the east end works the machinery which runs the pumps is now being used to operate the mixers, and thus a saving in fuel is effected. Mr. Barrow expects, in time, to bring the cost of operation to a much smaller figure than at present. From the number of changes proposed it would appear that plant is at present found to be expensive.

A BRIDGE has recently been completed at Dundas, Ont., that is a decided departure from the usual class of work done by municipal councils. To protect the banks from the cutting action of freshet water, caused by the curving of the current at this point, the abutment walls were made just high enough to provide a margin for highest freshet known, and on the tops of these walls steel rail piers were placed to support the superstructure, and the abutment walls carried up and down stream in such a way as to turn the current, making in all a length of wall of about 200 feet. The walls were topped with a cap having a half-round face, with 4-inch projection and 12 inches depth. All of this work is of concrete construction. John S. Fielding was the designer and contracting engineer; J. F. Armour, the town engineer, in charge.

H. J. BEEMER, president of the Pontiac and Pacific Junction and the Ottawa and Gatineau Railways, stated recently that preparations for beginning active operations on the new bridge that is to be built across the Ottawa from the city of Hull at Nepean Point were well under way. The contract for the substructure has been given to a New York firm, while the superstructure will be built by the Dominion Bridge Company. There will be five piers, with a cantilever span of 550 feet in the clear, with arms of 250 feet each. The total length of the superstructure, according to the plans, is to be about 1,300 feet. The bridge will carry a railway track, two tracks for electric cars and a sixteen feet roadway on each side. The object of the 550 cantilever span is to get the piers out of the great accumulation of sawdust in the Ottawa river. The total cost is estimated at about $750,000.

THE following are some of the orders lately received by the Goldie & McCulloch Co., Limited, Galt, Ont. J. R. McComb, flour mill and oatmeal mill, including engine, etc.; Jas. Pender & Co., St. John, N.B., "Ideal" engine; Michigan Central Railway Co., two locomotive boilers; Montreal Transportation Co., Kingston, "Ideal" engine; Delhi Fruit Co, Delhi, one heater; C. G. Gelinas & Co., Three Rivers, "Wheelock" engine; Jas. Richardson & Co., Kingston, "Wheelock" engine, boiler, condenser, shafting, etc.; Maritime Sulphite Fibre Co., Chatham, N.B., heater; Orangeville Electric Light Co., Orangeville, one boiler; Cronkhite Bros., Wisawasa, engine, boiler, heater, etc.; J. S. Metcalf & Co., Chicago, elevator at Coteau Landing, "Wheelock" engine, condenser, feed pump, two boilers and one "Ideal" engine; G. M. Angier & Co., Boston, for Asylum at Fairville, N.B., two "Ideal" engines, two boilers, heater, feed pump, etc.; N. Wenger & Bros., Ayton, one "Ideal" engine; Ogilvie Milling Co., Winnipeg, Man., two boilers; Dominion Bank, large bankers' safe; Electrical Power and Manufacturing Co., Hamilton, engine, boiler, etc.; Molson's Bank, Montreal, two bankers' safes; D. Marshall & Co., Aylmer, two boilers, heater, etc.; Wm. Hamilton Manufacturing Co., Peterboro, six boilers; M. Beatty & Sons, Welland, one boiler; the T. Eaton Co., Toronto, two "Ideal" engines; S. Lennard & Sons, Dundas, one "Wheelock" engine; Bank of Hochelaga, Sherbrooke, large bankers' safe; Bank of Hamilton, Hamilton, large bankers' safe.

A THEATRE to cost $30,000 will be built in St. Roch's, Que.

THE Granby, Que., rubber factory is being extended. Neil & Kent have the contract at $8,500.

THE Welland Vale Bicycle Co., St. Catharines, Ont., have shipped recently 50 wheels to Austria.

ARTHUR DENISON, Toronto, architect, has passed the Walkerton town hall, and taken it off the contractors' hands.

A CONTRACT for building a bridge over the Holland River near Bradford, Ont., will be let during the coming summer.

RIDGETOWN, Ont., has offered a large bonus and exemption to W. E. Hall, furniture manufacturer, Galt, Ont., to remove to that town.

THE Ontario Rolling Mills, Hamilton, Ont., lost no time in getting their premises into shape after the fire, and will soon have everything in as good condition as formerly.

RHODES, CURRY & Co., Amherst, N.S., recently obtained a contract to build 50 twenty-ton box cars for use on the extension of the Drummond Counties Railway at Montreal.

WORK at the Shawenegan Falls, above Three Rivers, Que., is to start shortly, and the hotel there has been reopened for the accommodation of tourists and people connected with the works.

DARTMOUTH, N.S., has a proposition before it to bonus a pulp mill to have a capacity of 20 tons per day. The promoters have secured options on suitable water power and land in the town.

THE Taylor Air Compressor Company, of Montreal, is installing a 500 h.p. plant at Ainsworth, B.C., and expects to distribute the power to mines within a radius of five miles. A full description of this plant will be found on another page.

THE Almonte, Ont., town council has been approached by the Perth Waterworks Co., asking if the council would be willing to enter into negotiations, even in an informal way, with the ultimate view of granting them a franchise for the supply of water and light.

THE Three Rivers, Que., Iron Works is completing the erection of a large brick machine shop and foundry, in connection with their already extensive works. The firm has large contracts on hand, which will give full work to their establishment for the next few months.

AT a recent meeting of the Essex County, Ont., Council the Road and Bridge Committee sanctioned the construction of the following: New bridge over River Canard, cost $1,732; new bridge over Bell River, cost $1,099; new bridge over Tremblay Creek, on county line between Essex and Kent.

IN April, 1897, the Cooper Machine Company of Toronto was incorporated, with $20,000 capital, one-fourth of which was paid. Last month the creditors had a meeting, and their statement showed assets of $4,800, against liabilities of $5,500. An offer of 40 per cent. was made and accepted.

THE local papers in Almonte, Ont., are discussing a system of water works for that town. The finances of the town are in good condition, and such a scheme might be put through; however, the laying down of the mains would be a most expensive undertaking, as almost every foot of excavation would be rock cutting.

JOHN MCCONNELL, of McConnell's Electric Carriage Works, Guelph, Ont., has invented a carriage wheel which ought to prove a revelation in carriage manufacture. The new wheel is set on roller bearings and has no boxings to break or get loose. It is dustproof, and requires oiling once in a season, there being no friction to require the continuous use of oil.—*Guelph Herald.*

THERE was a meeting of the Iron Founders' Association of Montreal recently, in the reading room of the Laurie Engine Company. Among those present were: W. H. Laurie, H. R. Ives, J. H. Garth, Thos. Monaghan, Wm. Rodden, John Laurie, E. Lamb and G. H. Weaver. During the evening a most interesting paper on "The Chemistry of Iron" was read by Ernst A. Sjostedt.

THE board of management of the public works of St. John, N.B., will receive tenders till April 1st for the supplying of about 3,116 tons of best quality 24 and 12 inch cast-iron water pipe, according to specifications and drawings prepared by Wm. Murdoch, Esq., C.E., engineer and superintendent S. and W. Supply, copies of which specification may be had on application to the director, A. Chapman Smith.

IN our last issue, THE CANADIAN ENGINEER stated that a writ had been issued against the Welland council of 1897 by the Waterous Engine Works Company, claiming damages for the non-fulfilment of a contract to purchase a fire engine. The statement, we find, is incorrect. A local informant states that our item might truthfully refer, however, to the village of Fort Erie, which is having some trouble with the Waterous Company.

THE secretary of the General Hospital, at Kingston, Ont., has been instructed to advertise for tenders for the reconstruction of the Watkins' wing, the cost of which is estimated at $12,000. The plans provide for twenty rooms. The question of putting in an elevator has not yet been decided.

THE Somerville course of lectures for 1898 at the Natural History Society Hall, Montreal, has been announced. The following lectures will interest our readers: Thursday, March 24th—The Modern Steamship, by Prof. A. J. Durley, B.Sc., Assistant Professor of Mechanical Engineering, McGill College. Thursday, March 31st—Precious Metals: Where they come from and how they occur, by Prof. F. D. Adams, M.A.Sc., Ph.D., president of the Natural History Society. Thursday, April 7th—Coal and Iron, by Osmond E. LeRoy, B.A., of McGill College. Thursday, April 14th—Our Railways, by Prof. Cecil B. Smith, M.A.E., Assistant Professor in Civil Engineering, McGill College.

IN the works of the Robb Engineering Co., Amherst, N.S., has a concern of world-wide reputation. At present, in every department, the hum of industry is heard, not only during the day, but night. Recently there was a test of a Robb-Armstrong engine. This one, which is compound, goes to Europe to be placed in an electric installation, and will be completed and ready for shipment at an early date. It is 125-h.p. Besides this one just referred to, three compound engines of the same type, each 200-h.p., being made for a foreign order, two of 225-h.p. each, for the Rathbun Co., Deseronto, Ont., and two more of 150-h.p., each, simple, for St. Thomas, Ont. These engines are of the side-crank type. In another part of the premises a large boiler is being finished, which will go to Parrsboro, N.S. It is known as the Mumford improved patent boiler. It is entirely cased in, with furnace in centre, and the smoke returns round the outer part of the shell. The boiler is arranged so that the water has a positive circulation, and the steam is collected in a large horizontal dome at the top. The whole arrangement is such that a great saving in fuel is claimed to be effected.

THE new steel swing bridge across the Lachine Canal at Seigneurs street, Montreal, for which tenders have been called, is to replace the present old structure, which is too light in construction to allow of an electric car service. It has only a clear roadway of seventeen feet, and a total width of twenty-eight feet. The new structure will have a clear roadway of thirty-seven feet, with two sidewalks of four and a half feet in width, and a clear roadway of twenty-six feet. Its length will be one hundred and thirty-eight feet between ballast walls, and be about eighteen inches higher than the present structure. The Atwater avenue bridge across the Lachine Canal is expected to cost about $75,000. The bridge is to be a swing bridge, with a clear span between abutments, ballast wall of two hundred and forty-three feet. The total width of the bridge will be thirty-eight feet, giving five-foot sidewalks on each side. The bridge can be built during the season of navigation, the abutments being placed far enough from the canal bank, so as not to interfere with the canal walls. The centre pier is founded on concrete placed within a square made of piles, with rods passing through the walling pieces. The rest pier work down the centre of canal, is composed of cribs, with ten-foot openings, and will be about two hundred and ninety feet in length.

RECENTLY a number of the people of Sarnia, Ont,, witnessed at the Doherty Stove Works a test of T. Doherty's latest improvement in iron casting—the transforming of cast iron directly into steel by an air blast, passed through the melted metal as it emerges from the cupola. For some time Mr. Doherty has been at work on a new method for decarbonizing iron in the process of casting and bringing the resultant metal to a higher grade of steel than was obtainable by his original process. The basis of the latter was the introduction of a steam jet to the cupola. The new process is based upon the use of compressed air. A specially designed cupola also forms part of the new process, we are informed by a local contemporary. The metal, as melted, drops in a small stream through the bottom of the receptacle to a receiver below, and as it falls through a powerful blast of air is directed against it, which blows out the impurities, which find escape through an opening in the back of the cupola. The effect of the introduction of air under pressure is marvellous. The carbon, sulphur and silicon in the iron can be eliminated to any extent desired by the foundryman by regulating the pressure, with the result of producing a steel casting suitable for the class of work for which it is required. At the test described the blast was regulated for stove plate casting and did not show the highest results obtainable, but it clearly demonstrated the superior character of the process over that of the original patent. Metal produced under the air blast process shows all the characteristics of steel under the hammer, the drill or the lathe, and there appears to be no doubt that Mr. Doherty has solved the problem of producing steel from ordinary pig iron at a single process, at once simple and cheap.

J. E. Lusby intends starting a feed mill at Amherst, N.S., in a short time, and has ordered a 40-horse power boiler and engine from the Robb Engineering Co.

Senator Poirier, Shediac, N.B., has ordered a 60-horse power engine and boiler from the Robb Engineering Co., Amherst, N.S., for running a flour mill and shingle mill.

An application has been made for a charter under the name of the Nickel Steel Company of Canada, the incorporators being: John McLaren of Brockville, manufacturer; George B. Douglas, of New York, manufacturer; Alexander Fraser, of Ottawa, lumberman; David McLaren, of Ottawa, lumberman; F. F. Vandervoort, of Pittsburg, manufacturer; George A. Cox, of Toronto, capitalist; Nathaniel Dyment, of Barrie, lumberman; Alexander McLaren, of Buckingham, lumberman; Andrew Trew Wood, M.P., of Hamilton, merchant; John Moodie, of Hamilton, capitalist, and John Patterson, of Hamilton, secretary. The company wants power to "explore for, develop, operate and acquire by purchase, lease or otherwise, gold, silver, copper, nickel, lead, iron, coal and other mines and properties, and to dispose of the same by sale, lease or otherwise; to manufacture and treat metals, minerals and ores, and to carry on the business of manufacturing therefrom and in combination with other metals, minerals, ores, substances and minerals and all articles of merchandise that may be manufactured therefrom." It also wants power to construct railways to reach or connect the mines, etc., and to establish steamship lines. John Patterson, Hamilton, the promoter, says there is $20,000,000 of capital behind the enterprise.

# Electric Flashes.

The Guelph Light and Power Company recently started up its new Brush arc machine.

The Cardinal, Ont., Electric Light Company, Limited, has been incorporated; capital, $20,000.

The Buckingham Reduction Co. of Buckingham, Que., is installing a 200 K.W. power generator. The order was given to the Royal Electric Co.

The Richmond County Electric Co. has purchased a 60 K.W. "S.K.C." two-phase generator from the Royal Electric Co.

The Toronto Railway Company has just placed an order with the Canadian General Electric Company for 20-G.E. 1,000 motors with K-10 controllers.

S. Lennard & Sons, of Dundas, placed an order some time ago with the Canadian General Electric Company for a 100-light incandescent plant.

The Ossekeag Stamping Company, Hampton, N.B., has purchased a 200-light incandescent plant for lighting the works from the Royal Electric Co.

The Sherbrooke, Que., Street Railway Company has recently placed an order with the Canadian General Electric Company for additional G.E. 1,000 equipments.

The British Columbia Railways Company has placed an order for a freight car, using "Brill" trucks and G.E. 1,200 motors, with the Canadian General Electric Company.

The Electric Light Co., Edmonton, N.W.T., has purchased a new plant complete, including a 75 K.W. "S.K.C." two-phase generator, with "Stanley" transformers, from the Royal Electric Co.

The Midland Electric Light Co., Midland, Ont., recently placed an increase order with the Canadian General Electric Co. for a 60-kilowatt, single-phase alternator of the company's standard type.

The Metropolitan Street Railway Company, Toronto, has placed an order with the Canadian General Electric Company for G.E. 1,000 equipments to replace the motors burned in the fire recently at the car barn.

W. B. Davey will immediately commence work for the lighting of Grand Forks, B.C. The order for the electrical machinery complete, including a 1,500 light alternator, has been given to the Royal Electric Company.

The Chateauguay and Northern Railway Co., Montreal, has placed an order with the Canadian General Electric Company for a 325-kilowatt steel frame generator. This will give that road a total capacity of 525 kilowatts.

The Hull, Que., Electric Company has ordered thirty-six G.E. 1,000 motors from the Canadian General Electric Company. These will be used as four-motor equipments, making in all fifty-two motors of this type which the Hull electric road will have in operation.

The Canadian General Electric Company is supplying three small direct connected units for the C.P.R. steamships on the Stikine River. These machines will be 4 kilowatts each, direct connected to vertical engine of special type, running at 600 revolutions per minute.

The Canadian General Electric Company has been awarded the contract for supplying electrical machinery for lighting and power purposes at Ashcroft, B.C. The three-phase system will be used, and the pumping for the town waterworks will be done by an induction motor.

The Canadian General Electric Company has closed a contract with the Montreal Transportation Company at Kingston, Ont., for a 25-kilowatt generator of the well-known direct connected type. This machine will be used for lighting the new elevators and other buildings of the company at Kingston.

There is a good deal of favorable criticism of the kindly action of the Royal Electric Company in coming to the assistance of the Lachine Rapids Company, the power-house of which was burnt on the 6th ult. The Royal Electric Co. lighted Westmount and Mile End for its competitor.

The council of Orillia, Ont., has instructed Wm. Kennedy, jr., hydraulic engineer, Montreal, to visit the Ragged Rapids and give an estimate of the probable cost of the hydraulic work, with information as to the best methods, etc. The Canadian General Electric Co. and the Royal Electric Co. have been asked to estimate on the proposed municipal lighting and power plant.

The Canadian General Electric Company has been awarded the contract for supplying the entire electrical equipment for the new St. Thomas Street Railway. The order covers two 100 kilowatt generators, and eight two-motor equipments. The order for cars was given to the Ottawa Car Company, and for steam engine to the Robb-Armstrong Engineering Company, Amherst, N.S.

The Auburn Power Co. at Peterboro, Ont., has ordered a direct connected sub-station unit from the Canadian General Electric Company, consisting of a 75 horse-power induction motor. From this outfit current will be supplied at 500 volts to small power users throughout the town of Peterboro, it having been found that the high price of induction motors prevented their general use.

The Electric Reduction Company, of Buckingham, P.Q., have placed an order with the Canadian General Electric Company for a 1,000 horse-power three-phase revolving field generator to be used for electrolytic work. The machine will be similar to those installed at Lachine and West Kootenay, except that the current will be supplied at the low potential of 75 volts.

The Canadian General Electric Company has closed a contract with the E. B. Eddy Co., Hull, Que., for a 500 and 350-light multipolar direct current generator, for lighting its mills at Hull. With these machines will be installed standard marble panels containing instruments of the latest type. The contract also covers the supply of material for the wiring of the place in strict accordance with the latest standard requirements of the fire underwriters.

The Sydney Electric Light and Gas Company, of Sydney, C.B., is making extensive alterations and additions to the plant, and has placed an order with the Royal Electric Co. for one 60 K.W. and one 40 K.W. "S.K.C." two-phase alternator, these machines being connected to deliver 150 volts per phase. This is the fourth order that has been placed with the Royal Electric Co. for low tension generators of this type within the last few months, and is an evidence of the growing popularity of these machines.

The Toronto Railway Company recently placed an order with the Canadian General Electric Co. for an 850-kilowatt direct connected, direct current generator, which has since been installed and is now in operation in the power house. This machine is practically identical with one of the same type and size supplied by the Canadian General Electric Company to the Toronto Railway three years ago. The new machine is being installed to take the place of a direct connected unit, of another make, which had to be discarded.

The T. & H. Electric Co., successors to Kay Electrical Manufacturing Co., reports the following recent sales in Hamilton, Ont. Norton Manufacturing Co., 15-h.p motor; Bain & Colville, 20 light dynamo; Max Bernstein, 1-h.p. motor; Leitch & Turnbull, 10-h.p. and three 15-h.p. direct-connected elevator motors and attachments; Bain & Sache, one 1-h.p. motor and 12 light dynamo; Electric Light and Power Co., several motors; G. H. Meakins, Esq., one 1-h.p. motor; Ontario Plating Works, one 400 gal. plater; Domestic Specialty Co., one 5-h.p. motor; D. Moore & Co., Limited, one 150 gal. plater; Tolton & McKay, one 1-h.p. motor; City Brass Foundry, one 5-h.p. motor; Hand & Teale, one 1-h.p. motor; Post Office, one ½-h.p. motor; Geo. D. Membery, one 3-h.p. motor.

A BY-LAW for the establishment of an electric light system for Beeton, Ont., was voted on and carried by a unanimous vote a short time ago.

THE Welland, Ont., Aqueduct and Power Company has been organized, with a capital of $25,000, to supply electricity for light, heat and power.

THE Acadia Coal Company's charter, Stellarton, N.S., has been amended so as to permit the company erecting an electrical plant and all necessary requirements for electric lighting.

THE British American Light and Power Company is seeking incorporation to build electric tramways and operate systems for electric lighting in the Yukon district, Northwest Territories and Northern British Columbia.

CHIEF ENGINEER HOBSON, of the Grand Trunk Railway, and a representative of the General Electric Co., spent a day a short time ago looking over the tunnel, with a view to introducing electricity to supersede steam as a motive power.

THE Royal Electric Co. has presented its friends with a very handsome desk convenience, which consists of a very large and well-bound blotting pad, with a calendar and indexed engagements book in the margin. The whole souvenir is one of the most beautiful and serviceable articles it has been our pleasure to receive in a long time.

BY Ontario letters patent, the Saugeen Electric Light and Power Company of Ontario, Limited, has been incorporated. Charles Edward Kilmer, of Southampton, electrician; Clarence Hurd Burnham, of Port Elgin, electrician; Joseph Barber and James Barber, of Georgetown; Edward Kilmer, merchant, of Walkerton, are the parties. Capital, $20,000.

MARKHAM, Ont., has settled its claim against the Waterloo Mutual Fire Insurance Company, caused by the burning of the waterworks and electric light station on the 16th ult. The loss claimed by the corporation was $1,593, on which $1,550 was allowed by the company's inspector. The council started at once to rebuild. The new boiler and engine room will be made fireproof.

IN a recently published interview, B. S. Jenkins, superintendent of the Canadian Pacific Railway Company's telegraph, said that a heavy copper wire is to be strung from Montreal to the Pacific coast, the work to begin almost immediately. The new cable to be laid between Vancouver and Victoria left England on one of the company's new steamers recently purchased for the Yukon Territory trade.

THE first regular meeting of the Royal Electric Engineering Society was held in Montreal not long ago. The following were elected officers for the present session: Hon. president, Wm. H. Browne, general manager Royal Electric Company; president, Wm. Bucke; vice-president, W. S. Dix; corresponding secretary, R. F. Morkill; recording secretary, W. G. Angus; treasurer, L. A. Howland; librarian and curator, F. Cushing; committee, J. Burnett, L. Mudge, K. B. Thornton. This society has been formed by the members of the engineering staff of the Royal Electric Company, and has as its primary object the advancement of knowledge in engineering subjects.

THE Toronto Electric Motor Co., Toronto, and Thompson Electric Co., Hamilton, have amalgamated, the change in the firm to take effect on the 15th inst., under the name of "Toronto Electric Motor Co., Limited." The Hamilton factory will be moved to Toronto, and will occupy the new buildings which the company is to finish by the first of May. The new shops will be of the most modern type, with traveling cranes, etc. With this change the new company will be in a position to do the heaviest work in power apparatus, also arc and incandescent work of every kind. All communications should be addressed to Toronto Electric Motor Co., Limited, 107 Adelaide St. West, Toronto, Ont.

D. A. STARR, president and manager of the Cornwall, Ont., Electric Railway Co., appeared recently before the council of Peterborough, Ont., and explained a scheme for the construction of an electric road from there to Chemong and Lakefield, and connecting in town with the Jackson and Nicholls park, and south to the locks. Mr. Starr said his company also proposed to place four steamers on the back lakes, one steamer to run to Stony Lake, two on the Lakefield-Chemong round trip, one leaving each place each morning, and the fourth running from Chemong to Bobcaygeon. The electric road, Mr. Starr explained, would handle freight, and give a half hour service between Peterborough and Lakefield and Chemong. The company propose to lease both the Chemong and Lakefield lines from G.T.R., convert them into electric line and take over its freight business. The former road would be diverted so as to enter the park. The cost was roughly estimated at $350,000, and the company asked the town to guarantee the interest for twenty years on $150,000 of bonds at 5 per cent.

THE new 2,000 light dynamo purchased by St. John's, Que., in January, to replace the present machine, has been installed.

WE are indebted to the Packard Electric Co., St. Catharines, Ont., for their neat monthly memorandum books and blotter calendars.

THE city of Three Rivers, Que., and the North Shore Power Company are negotiating for the running of the waterworks by electricity.

CHAS. MACBETH, son of Col. Macbeth, London, Ont., has been appointed engineer-in-charge of the construction of the St. Thomas street railway.

THE town council of Napanee, Ont., has accepted a proposition made by J. R. Scott, agreeing to install an incandescent and arc plant within one year.

AN accident to the generating plant of the Electric Power Co., at Montmorency, left the twenty thousand incandescent lamps in Quebec City in darkness, on Sunday, 27th February.

ENGINEER LEYDEN, of the Cataract Power Company, has submitted to E. G. Barrow, city engineer, Hamilton, Ont., a proposition for running the sewage disposal works by electrical power.

THE Halifax and Bedford Electric Company is seeking incorporation to build an electric railway from Halifax to Bedford, with such extensions as may be approved of by the municipalities. The head office of the company will be in Halifax, and the capital stock is placed at $250,000.

IT is stated that the Montreal Street Railway Co. will leave its present power house to the Royal Electric Co., and that it will be kept in reserve in case of accident, when the new arrangements are put in operation by which the street railway will be run by power from Chambly.

THE British-American Light and Power Company are applying to the Dominion Parliament for power to construct and to operate by electricity and other power, tramways at Dawson City, Fort Selkirk, and points in the Yukon and North British Columbia; and to operate heating and lighting systems.

APPLICATION is being made for incorporation of the North Shore Electric Railway Company, with powers to construct a railway on the north shore of the St. Lawrence, starting from a point near Three Rivers and through the district of Three Rivers and other districts. Also to generate and sell electrical energy.

AT the next session of the Legislature a Winnipeg company will ask for a charter to build an electric railway from that city to St. Andrew's Rapids, and through the municipalities of Springfield, St. Boniface, Kildonan, St. Paul's and St. Andrew's. The company also propose to construct saw mills, boats, telegraph and telephone lines.

SHAREHOLDERS of the Hamilton Radial Electric Railway met Feb. 22nd to consider matters the outcome of the relinquishment of the Leather interest in the road. The business was not in shape for immediate consideration, however, and the meeting was adjourned for two weeks. With the retirement of Thos. E. Leather from the company it is probable that the original idea of continuing the railway through Burlington and on to Bronte will be dropped, at least for this year.

JNO. PATTERSON, engineer of the Cataract Power Co., Hamilton, is also interested in promoting the new company which is being formed to manufacture steel and nickel, and electric power will be used. The water will be taken from the Chippewa Creek and the power canal will be enlarged to double its capacity. The power houses will be at Reynoldsville, Ont. Mr. Patterson states that power will be generated by his company by May 1, although it will be months before the works are completed. Poles are now being distributed along the G.T.R., and power will be conveyed to Hamilton, Ont., along that route.

AT the annual meeting of the Toronto Electric Light Company, the financial statement presented showed a surplus of $7,000 over dividends paid. A steady growth is shown in the business all through the past year, especially in private incandescent lighting and power. The old board of directors were re-elected, as follows: H. M. Pellatt, president; W. D. Matthews, vice-president; S. F. McKinnon, Hugh Blain, W. T. Murray, Hon. Geo. A. Cox, Robert Jaffray, W. R. Brock, A. E. Ames, Samuel Trees, Thomas Walmsley, H. P. Dwight, Frederic Nicholls, Hugh Ryan. J. J. Wright, general manager; W. A. Martin, secretary.

THE annual meeting of the Bell Telephone Company was held in Montreal, February 23rd. The net revenue for 1897 was $297,751.57, and after dividends have been deducted the company will carry forward $82,364.17 to its 1898 account. There were present at the meeting: C. F. Sise, president; R. Mackay, F. X. St. Charles, G. A. Greene, P. R. Gault, Hugh Paton, C. R. Hosimer, R. Archer, R. W. Shepherd, Chas. Cassils, T. D. Hood, F. G. Payne, R. P. McLea, C.

A. Briggs, C. F. Paul, James Wilson, Herbert Wallace, George Sumner, H. A. Budden, M. S. Foley, E. Rawlings, John Crawford, J. A. Grenier, George H. Holt, D. Ross Ross, Charles Garth, F. B. McNamee, James Shearer, James Williamson. The annual report was submitted as follows : "Nine hundred and eighty-three subscribers have been added during the year, the total number of sets of instruments now earning rental being 30,445. The company now owns and operates 349 exchanges and 261 agencies. Thirty-five miles of pole and 703 miles of wire have been added to the long distance system in 1897; of these five pole miles and 200 wire miles are in the Ontario department, and 30 pole miles and 494 wire miles are in the Eastern department The long distance lines now owned and operated by the company comprise 16,567 miles of wire on 6,095 miles of poles. Under the authority of the shareholders $66.500 bonds have been sold during the year, the premium thereon being 10 per cent. Continuing the policy adopted in past years, your directors have charged to contingent fund $150,000, that amount having been expended during the year on construction rendered necessary by the introduction of trolley and other strong wires, but which has not increased the earning power of the plant. The following directors were elected : C. F. Sise, Robt. Mackay, John E. Hudson, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, Thos. Sherwin.

# Railway and Marine News.

THE story is revived that the C.P.R. will erect a million bushel elevator at St. John, N.B.

IT is proposed to run one of the Conneaut car ferries to Port Burwell, Ont. this season, instead of both to Port Dover.

GEORGE F. BAIRD, Yarmouth, N.S., has purchased the steamer "City of Monticello," for a price in the vicinity of $20,000

A DEPUTATION from Lancaster, Ont , has requested the Dominion Government to make an appropriation of $10,000 for a wharf there.

THE Sault Ste. Marie *Star* says the steamer "Cambria" will be thoroughly rebuilt and again take her place on the Windsor-Soo route.

THE Alberta Railway Company have sold to Mackenzie & Mann, for use on the short line to Lake Teslin, a quantity of steel rails and four locomotives.

A SYNDICATE has been formed to operate two steamers on the Kingston and Wolfe Island ferry, and Kingston and Ganancque route, the coming season.

THE contract for building the Cobourg, Northumberland and Pacific Railway, running north from Cobourg, Ont., to the C.P.R., has been signed by C. H. Bowen.

IT is stated on good authority that the present intention of the company which controls the M. & N.W. Railway is to extend the line to Prince Albert this year.

THE Grand Trunk Railway authorities are putting new colonist cars on their Winnipeg route that for comfort and appearance excel anything of the sort yet seen in this country.

REPRESENTATIVES of D. C. Corbin have succeeded in obtaining the endorsation of the council of the Rossland Board of Trade for a railway charter from Cascade City to Grand Forks.

THE Grand Trunk Railway system has received for service in its western traffic ten locomotives of the heaviest and most powerful build, from the Baldwin Locomotive Company, at Philadelphia.

THE contract for building the Midland Railway line from Windsor to Truro, N.S., 60 miles, has been let to Fitzpatrick Bros., New Glasgow. The road will be graded and ironed by next fall, it is said.

THE C.P.R. shops are busy turning out new passenger coaches and locomotives to meet the demand for new rolling stock created by the boom in business and the extension of its service in the West.

THE second compound locomotive ordered by the Canadian Government Railway System from the Baldwin Locomotive Works, Philadelphia, has been shipped to Montreal, where it will be put together.

THE Canadian Pacific Railway has sent a representative to Newfoundland to engage 1,500 laborers to proceed to British Columbia to work on the Crow's Nest Pass Ry. The wages offered are $1.50 a day.

THE Government has decided to send immediately the chief engineer of the Department of Public Works, Louis Coste, and the chief engineer of the Department of Marine, Lt.-Col. Anderson, to the Stikine River and over the Canadian route to Dawson city, for the purpose of seeing what improvements are necessary to overcome obstructions to navigation. It is also the intention to erect a wharf at Dawson after inspection.

THE new pier at Margaretville, N.S., is completed, and the cost, $10,854, slightly more than the tender of the contractors, Simmons & Burpee, Gibson, N.B. The work has been done to the entire satisfaction of the Dominion Government engineer, C. E. W. Dodwell. As Margaretville is the nearest approach to a natural harbor on the Nova Scotia shore, between Minas Channel and Digby Gut, the necessity of a safe breakwater has been admitted.

THE Newfoundland cabinet has concluded an arrangement with R. G. Reid, the contractor who built the Transinsular Railway, to operate the entire railway system of this colony, six hundred miles, for fifty years, in return for a land subsidy of 2,500 acres per mile. Mr. Reid will pay over to the Government one million dollars guarantee. This money, with the interest accumulations for fifty years, will belong to the colony at the expiration of that period, the railway then reverting to the representatives of Mr. Reid.

DAVIS Dry Dock Company is very busy this spring filling orders for launches, etc. There are being built a passenger and freight steamboat for Homer & Co., of Gravenhurst, Ont.; 25-foot steam launch for Muskoka Lake; three boats for the Adirondacks, for New York owners; one 17-foot ¾ h.p. gasoline motor; one 20-foot long gasoline motor; one 36-foot long steam engine, beside one 34 feet long and another 50 feet long on the stocks. They are getting out plans for a 20-foot boat with a small steam motor to fit back in the stern, a very pretty little launch, with plenty of room and at a very small cost.

THE steamer "Tecumseth," owned by McArthur Bros., Toronto, will undergo considerable alterations to her machinery this season at the hands of the Bertram Engine Works. The two present fire-box boilers, which are allowed 65 lbs. per square inch, will be removed, and replaced by one "Scotch" boiler 11 feet diameter, with a working pressure of 130 lbs. per square inch. This boiler will be fitted with a complete installation of the "Howden Hot Air Draft," in which the air is considerably heated by the escaping funnel gases before being forced into the ashpits. The present cylinders, which are 26 and 48 inches diameter, will be replaced by new ones of 19 and 40 inches diameter, the rest of the engine remaining practically as at present. The results anticipated are an increase of power, economy of fuel, both as regards quality and quantity, less weight of boiler, and more stowage room in the ship. As this is the first installation of the "Howden" draft on a Canadian lake vessel, it will be watched with interest. The work is under the supervision of A. P. Rankin, consulting engineer, of Toronto.

CHICAGO forwarders have sent out the following circular :—"It is our intention to put on three boats from Chicago to Parry Sound, the capacity of which will be in the neighborhood of 3,000 tons each, which will call at Milwaukee; also, two boats from Duluth, with about the same capacity. At Chicago we have leased a dock between the Ogdensburg Transit Company and the Lehigh Valley Transportation Company's dock, on which there is being erected a warehouse about 125 feet long, with an average width of 110 feet. At Parry Sound we have an elevator now ready for the handling of grain, with a capacity of about 1,250,000 bushels, and will have a warehouse 600 feet long by 80 feet wide, also a flour house 600 feet long by 80 feet wide, together with 2,500 feet dockage accommodation, on a 22-foot water line. We are also building at Coteau Landing, on the St. Lawrence river, at the mouth of the Soulanges Canal, a transit elevator, of 500,000 bushels' capacity, which will handle 240 carloads a day, also a warehouse and docks of sufficient dimensions for the handling of flour and package freight, our idea being to float our grain and package freight to Montreal and deliver alongside of the ocean vessels in Montreal harbor."

# Mining Matters.

OIL has been struck at Croton, Bothwell county, Ont. The field is said to extend over an area of several miles. Some splendid wells have been struck on the town line of Zone and Camden.

THE Hall Mines Co. has closed a contract with the Dominion Wire Rope Company, Limited, Montreal, for 10 miles of wire rope for its cable way from the mines to the smelter. Its weight will be about 40 tons, and it will be made in six sections of over 1½ miles in length, for convenience in handling.

WHAT is known as the Dickenson mine in Michipicoten, Ont., has been sold to an English syndicate. George Fee, and J. J. Mackey, of North Bay, and J. L Caverhill, Montreal, were the vendors. E. A. Bremner, an English mining expert, acted for the syndicate. This claim was the first discovered in the Wawa, Ont., district.

CONSIDERABLE excitement has been caused in the county of Megantic, Quebec, by the discovery of gold on the banks of the Bullard Brook. The discovery was made late in the autumn, and several pits have been sunk, and in every case gold in small quantities has been found in the black sand that seems to be scattered over the whole of the flats.

THE annual meeting of the shareholders of the Intercolonial Coal Mining Company, Limited, took place recently, in Montreal. The sales of coal and coke, for the year ending Dec. 31st, 1897, amounted to 186,654 tons. The following were elected directors of the company for the ensuing year, viz.: James P. Cleghorn, president; H. S. MacDougall, W. M. Ramsay, Thomas Wilson, E. Goff Penny, M.P.; A. W. Hooper, R. MacD. Peterson, Charles Fergie, vice-president, and Wm. J. Nelson.

IN a report to Arch. Blue, director of the Bureau of Mines, Ontario, Prof. De Kalb, the new professor of mining engineering at Kingston School of Mining, says that the corundum in the counties of Hastings and Renfrew is very rich. Tests have been made showing that concentrates may be made giving ninety-two to ninety-four per cent. of corundum, and as the commercial standard of purity only requires eighty per cent. of corundum, it appears that this limit can be easily passed. Another thing that he says is that there is little difficulty in separating the corundum from the magnetite.

THE Geological Survey of Canada has just issued a summary of the mineral production of Canada for 1897, which, without being final—some of the figures not being obtainable just at present—is based on a general knowledge of the progress made in the various industries, and is sufficiently accurate for all practical purposes. The report shows that the value of the gold produced amounted to $6,190,000; of copper, 13,300,802 pounds were produced, value, $1,501,660; of lead, 39,018,219 pounds, value, $1,396,853; of nickel, 3,997,647 pounds, value, $1,399,176; of silver, 5,558,446 ounces, value, $3,322,905; of iron ore, 71,451 tons of two thousand pounds, value, $178,716; of mercury, 688 pounds, value, $324, and of platinum a value of $6,600. The report will be taken up fully in a later issue of THE CANADIAN ENGINEER, when the production in the United States will also be given, so that the relative increase in the two countries may be considered.

## Personal.

WE regret to state that Wm. Hamilton, manager of the St. Lawrence Foundry, Toronto, was stricken with paralysis recently.

WM. MCLEAN, of the McClary Manufacturing Co., Limited, London, has gone to take charge of the company's office in Winnipeg.

P. S. ARCHIBALD, ex-chief engineer of the I.C.R., is engaged by Sir Charles Tupper as chief engineer of the Klondyke Mining Company.

T. H. WHITE, St. Thomas, Ont, has been appointed chief engineer for the new line of railway to be built from the Stikine River to Teslin Lake.

HENRY BUDDEN, vice-president and managing director of the Intercolonial Coal Company, of Pictou, N.S, has resigned that office on account of ill health.

JAMES WARNOCK, one of the most prominent citizens of Western Ontario and a leading manufacturer in Galt, Ont., proprietor of the Galt Edge Tool and Axle Factory, died at his home the 5th February.

W. A. CARLYLE, British Columbia provincial mineralogist, has handed in his resignation, to take effect April 1, when he will leave for Rossland to accept the mining superintendency of the British America Corporation.

RICHARD G. MCCONNELL, geologist of the Dominion Geological Survey, has been appointed mineralogist of the British Columbia Government at a salary of $4,000. Mr. McConnell has been with the Geological Survey since 1879, when he graduated from the science school of McGill University.

IN attempting to remove a piece of wood that had stuck fast in a bed planer, Norton Olds, employed in the Mann Manufacturing Co.'s works, Brockville, Ont., accidentally placed his right hand in the knives, which gradually drew the arm in, cutting it off by inches to within a short distance of the shoulder.

MRS. ANN OWEN GREENING, widow of the late Benjamin Greening, founder of the B. Greening wire works, Hamilton, Ont., died at the residence of her daughter, Mrs. R. H. Merriman, Hamilton, recently, aged 88 years. Her husband died 21 years ago. Five sons and two daughters survive her.

CHAS. B. BROWN, of the Ontario Rolling Mills, Hamilton, Ont., has gone to Tacoma, Washington, to accept the position of superintendent of the Western Iron and Steel Company. Before leaving he was presented with an address and a purse of gold by his fellow employees of the rolling mills.

CHAS. DAWSON, who for the past five years has been Works Superintendent for the Central Bridge and Engineering Co., Peterboro, Ont., and was formerly with the Canadian General Electric Co., as master mechanic for the Engineering Department, has resigned his position with the former and has accepted the position of Assistant Superintendent with special charge of all Machine Tool Work for the Dominion Bridge Co., Montreal.

WILLIAM HOLTBY, mechanical engineer of the Canada Atlantic Railway, Ottawa, was accidentally killed at Coteau Junction, Que., Feb. 23rd. He was superintending the replacing of a snow-plough on the track, when he slipped and fell under the train. Mr. Holtby had been a resident of Coteau Landing during the construction of the Canada Atlantic Railway transfer, of which he was the foreman. At the inquest, the jury brought in a verdict that deceased was the victim of an accident due to his own imprudence.

ALEX. DUFRESNE, one of the engineers on the Soulanges Canal, had a narrow escape from drowning Feb. 25th, while sounding for the depth of the water at the head of the canal. Mr. Dufresne, together with A. G. Grant, another engineer, was engaged with his instruments, when the ice suddenly gave way, carrying him with it. Mr. Grant, at the risk of his life, seized Mr. Dufresne and succeeded in pulling him out of the water. The place was a dangerous one, being 25 feet deep and at the head of the Coteau rapids.

## LITERARY NOTES.

We have received the "Transit," a pamphlet of 170 pages, published by the engineering society of the State University of Iowa, U.S. It contains some valuable and interesting papers on engineering topics, chiefly by graduates of the University.

We have before us the Proceedings of the Seventh Annual Convention of the Association of Railway Superintendents of Bridges and Buildings. It contains in 275 pages a number of valuable papers profusely illustrated.

The "Mining Resources of Canada" is a pamphlet of about a dozen pages of printed matter and as many more of handsome photo-engravings, issued by the Department of the Interior, Ottawa. A great many statistics are given of the mineral productions of Canada in the past and information about the mineral regions. A large map of the Dominion is also included.

## FIRES OF THE MONTH.

Feb. 2nd.—McIntyre block of stores and offices, Winnipeg, Man. Loss about $500,000; to be rebuilt.——Feb. 13th.—Ontario Rolling Mills, Hamilton, Ont., the main building destroyed; the loss was $16,472. The machinery, etc., was insured for $28,000, and the building, owned by the Grand Trunk, for $6,000.——Feb. 16th.—The power house and plant of the Markham, Ont., electric light and waterworks; loss about $3 500.——Feb. 16th.—George Middleditch's foundry and machine shop, Bothwell, Ont. Loss about $7,000.——Feb. 17th.—Waterloo, Ont., Manufacturing Co.'s foundry; damages, $400.——Feb. 19th.—Bismarck cheese factory, near Wellandport, Ont., burnt down; loss about $2,500.——Feb. 19th.—Barrel factory, Lequille, N.S., property of the Union Bank of Halifax; loss about $15,000.——Feb. 20th.—Flour mills, Burlington, Ont., run by W. H. Finnemore, owned by Estate P. Redpath, Montreal; loss about $10,000.——March 4th.—The Goold, Shapley & Muir windmill and bee supply factory, Brantford, Ont.; loss about $20,000.

—A hot air radiator, of special value to all users of wood burning stoves or furnaces, has been invented by R. W. Biggar, Sorauren ave., Toronto. It is a drum to be applied to a stovepipe in the ordinary manner, but, unlike any other heating drum we have seen, it sucks up the cold air from the floor of the room and throws it out at the top of the drum, thus keeping all the air in the room in circulation, and abolishing finally cold floors.

—The Hamilton Acetylene Gas Machine Company's generating apparatus, of which an advertisement appears on another page, possesses many features which make it of great value. The patent water spray, by which the water is supplied to the carbide in the generator, is a special feature of great interest. A further description of this machine will be given in the next issue of THE CANADIAN ENGINEER.

## SOME EXPERIMENTS ON THE CONDENSATION OF STEAM.*

By H. L. Callendar, M.A., F.R.S., Professor of Physics, and J. T. Nicolson, B.Sc., Professor of Mechanical Engineering of McGill University, Montreal.

Part I.

As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam-engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite but finite and measurable. An account of these experiments was communicated to the Institution of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing session. In the meantime, the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view to verify the results of their previous work, and also to estimate the influence, if any, of the film of water adhering to the walls of the cylinder.

In considering the condensation of steam on a metal surface it is usually assumed that the surface exposed to the steam is raised up to the saturation temperature corresponding to the pressure of the steam, and that the amount of condensation is limited by the resistance of the water films to the passage of heat from the steam to the metal and from the metal to the water. If the steam contains air, there may also be a considerable resistance due to the accumulation of a film of air on the surface, but it is comparatively easy to exclude this possibility in experimental work.

In the steam-engine experiments, above referred to, it was practically certain that the water film due to the cyclical condensation never exceeded one-thousandth of an inch in thickness, and that the resistance offered by it was unimportant. At the same time, it appeared clear that the temperature of the surface of the metal at its highest was considerably below the saturation temperature of the steam: a condition which could only be explained by supposing the rate of condensation of steam on a surface to be limited by some physical property of steam itself, apart from the resistance of the condensed film of water. Interpreted in this manner, the experiments led at once to the conclusion that the rate of condensation at any moment was simply proportional to the difference of temperature between the saturated steam and the surface on which it was condensing.

The limit thus found was shown to be capable of explaining many of the phenomena of cylinder condensation in a rational manner; but the method by which it was established was of an indirect and somewhat intricate character, and appeared to require some simple and more direct confirmation.

If the rate of condensation of steam were really infinite, it should be possible by a suitable modification of the surface-condenser method (i.e. by getting rid of the water films on the outside of the tubes) to obtain values of the condensation considerably in excess of those given by the formula deduced from the temperature cycle observations.

To accomplish this, it is necessary to eliminate as completely as possible the resistance to the passage of heat through the water films between the steam and the metal, and between the metal and the circulating water, and at the same time to measure as accurately as possible the temperature of the metal.

These considerations led to the form of apparatus which was employed. The resistance to the passage of heat from the metal to the condensing water in this apparatus is practically eliminated by employing a thick cylinder, 5 in. diameter and 2 ft. long, with a screw thread cut on its outer surface. Water from the high-pressure mains is forced to circulate round this surface with a very high velocity in the narrow space between the cylinder and the surrounding tube. In this manner it is possible to obtain a very uniform temperature for the external surface differing but little from that of the circulating water.

If the cylinder is made sufficiently thick, its temperature may be approximately determined at any depth by inserting mercury thermometers. It was intended at first to use thermo-couples for this purpose, but the apparatus in this form would have been unsuitable for students' use in the ordinary course of laboratory work, which was one of the primary objects in view in the construction. It would also have been desirable to make the cylinder of nearly pure copper, which would have reduced the resistance of the metal to the lowest point. The authors were compelled, however, to content themselves for the time with cylinders of cast iron and of mild steel.

The internal surface of the cylinder, upon which the steam was condensed, was a hole one inch in diameter, drilled in the solid metal. In order, as far as possible, to minimize the resistance of the surface film of condensed water, a revolving brush was constructed of very thin strips of steel to wipe the surface five or six times a second. This wiper was found to wear in a very short time to so perfect a fit and the water film must have been so energetically stirred that its resistance to the passage of heat must have been far less than that of the best conducting metal, when there was perhaps some small film present.

Under these conditions, if the rate of condensation of steam were infinite, it should have been possible to obtain a rate of condensation many times greater than the limit deduced from the cylinder-condensation experiments above mentioned.

On making the experiment, however, it was found that the wiper made very little difference to the amount of condensation. With the wiper revolving at the rate of 160 per minute, the condensation was increased by about 5 per cent. on the average of several experiments. It may be concluded from this that the drops of condensed water with which the surface is partially covered are in such rapid motion that they do not appreciably obstruct the passage of heat from the steam to the metal. In fact, Prof. Callendar actually found that the drops increased the condensation. A film of the same average thickness, if it were absolutely quiescent, and if its conductivity, as generally estimated, were only one-hundredth of that of cast-iron, would no doubt prove a serious obstacle; but, as a matter of fact, the viscosity of water at these temperatures is so small, and the motion so rapid, that the drops cannot be treated as a quiescent film.

The temperature at various distances from the inner surface of the cylinder was determined by means of mercury thermometers inserted to a depth of 8 in. or 9 in. in holes drilled parallel to the axis. From the temperatures so observed the conductivity of the metal and the temperatures of its inner and outer surfaces could be approximately inferred. It was found, however, that the presence of the holes interfered materially with the flow of heat through the metal, and that the readings of the thermometer under these conditions were not altogether trustworthy.

From a number of observations on the cast-iron cylinder a conductivity of 5.5 thermal units Fahr. per square ft. per minute per deg. Fahr. per inch was deduced, a result which agrees very closely with the authors' previous determination by a different method. For the steel cylinder a conductivity of 5.8 was similarly deduced. These results apply to a mean temperature of about 140 deg. Fahr., and are much lower than the values generally assumed for iron.

In order to verify the previous results as to the rate of condensation of steam derived from the steam-engine experiments, the temperature of the inner surface of the metal was calculated on the assumption of a rate of condensation equivalent to 0.74 thermal unit Fahr. per second per square foot per deg. Fahr. difference of temperature. The values so found agreed with the observed temperatures within the limits of error of the observations. Owing to the inferior conductivity of the iron the test was not absolutely conclusive, as the difference of temperature between the steam and the surface rarely amounted to as much as 30 deg. With a cylinder of pure copper, and thermocouples for determining the temperature at a given depth, it should be possible to obtain a more certain confirmation by this method.

In performing the experiments a number of variations in points of detail were introduced from time to time. The flow of the circulating water was varied in velocity, and directed in different ways. In order to secure uniformity in the distribution of temperature measured in different directions from the centre, the spiral circulation was found to be essential. In the second apparatus the screw thread was at first replaced by a baffle-plate, which was intended to direct the water into a spiral course, but the results found were unsatisfactory.

* A paper read at the annual meeting of the Canadian Society of Civil Engineers.

In some cases steam was admitted from the top of the apparatus, and in other cases from the bottom. With the steam supply at the bottom, it was found that condensed water refused to drain down the vertical 1-in. tube in opposition to the current of steam, although the maximum velocity of the steam could not have exceeded 10 ft. per second.

The following set of observations, each of which represents the mean of several taken on similar conditions, will sufficiently indicate the general nature of the results:

The temperatures of the metal at distances of 1 in., 1.5 in., and 2 in. from the axis of the bar were observed by means of mercury thermometers, which were very carefully centred by small iron washers in holes filled with mercury. The hole fitting the bulb of the thermometer was 3-16 in. in diameter. The other holes were 5-16 in.

It will be observed that in this particular set of experiments the temperatures at 1 in. in the metal, when calculated to agree with the assumed rate of condensation, are all too low as compared with those observed, whereas the temperatures similarly calculated at 1.5 in. are all too high. This might at first sight appear to indicate a very rapid diminution of the conductivity with rise of temperature; but after making various tests the effect was traced partly to the disturbance of the heat flow caused by the presence of the holes, and partly to differences of density of the bar in directions at right angles. The latter differences were not observable in the case of the cast iron.

The observations taken at different pressures do not indicate any marked difference in the rate of condensation per degree second. These results, so far as they go, are in agreement with the authors' previous work, but they hope to be able to obtain more conclusive evidence.

CONDENSATION RESULTS SUMMARY. MILD STEEL BAR. WIPER REMOVED.

| Condensation. Thermal Units per Square Foot Second. | Steam Temperature Observations. | Surface Temperature Calculations. | Difference, Steam and Surface. | Temperature in Metal at Distances. | | | | | Conductivity, K. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 In. | | 1.5 In. | | 2 In. | |
| | | | | Calculations. | Observations. | Calculations. | Observations. | Observations. | |
| | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. | |
| 20.0 | 330 | 303 | 27 | 208 | 214 | 154 | 152 | 113 | 5.84 |
| 17.8 | 300 | 277 | 23 | 193 | 198 | 143 | 142 | 109 | 5.66 |
| 15.7/8 | 274 | 253 | 21 | 179 | 184 | 136 | 134 | 103 | 5.81 |

1. With a short length of condenser and a very free escape of steam, the condensation observed was equivalent to 22.2 thermal units Fahr. per square foot per second, for a difference of temperature of 28.5 deg. Fahr. between the steam and the metal surface. This is equivalent to a rate of condensation of

(*Continued on page* XV.)

## AN ELECTRICAL METHOD OF MEASURING THE TEMPERATURE OF A METAL SURFACE ON WHICH STEAM IS CONDENSING.

By H. L. CALLENDAR, M.A., F.R.S., Professor of Physics, McGill University, Montreal.

PART II.

The object of the following experiments, which were made at the McDonald Physics Building with a different apparatus, was the measurement of the temperature of the metal surface itself by a more direct and accurate method. It was also desired to verify as exactly as possible whether the rate of condensation of steam at atmospheric pressure was the same as at the higher temperatures and pressures at which most of the preceding experiments were made.

The condenser used for these experiments was a very thin platinum tube, ¼ in. in diameter and 16 in. long. The thickness of the tube was only six-thousandths of an inch, and the greatest difference of temperature between its inner and outer surfaces at the maximum rate of condensation observed in the experiments could not have been greater than ¼ deg. cent.

The mean temperature of the metal itself was determined in each case by measuring the electrical resistance of that portion of the tube on which the steam was condensing. The author has had considerable experience in the employment of this method, which, moreover, is very easily applied if suitable apparatus is available.

The platinum tube was enclosed in an outer tube of brass or glass, and steam was admitted to the space between the two tubes. A steady current of condensing water was maintained through the platinum tube. The amount of condensation could be inferred by measuring the flow of water, and observing the difference of temperature between the inflow and the outflow. In many cases the condensed water was also measured. Applying a small correction for radiation, the two methods always agreed within one-half of 1 per cent. The pressure of the steam in the outer tube, which was never far from the atmospheric, was observed by means of a mercury column.

The conditions of the experiment as to flow of water and steam, size and length of the external tube, etc., could be varied within certain limits. The following is a summary of the more interesting results obtained:

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# The Canadian Engineer

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## The Canadian Engineer.

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WITH this issue Volume V. of the CANADIAN ENGINEER is completed. On application at this office an index of the year will be sent to any subscriber who wishes to bind the volume.

*For* THE CANADIAN ENGINEER.

## RAILWAY ENGINEERING.*


BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.


### CHAP. V.

### ROADBED CONSTRUCTION.

#### ARTICLE 28.—LAYING OUT AND MEASURING WORK.

Cross-sections should be taken at such intervals that the prismoid between two adjacent ones will have planes as boundaries on a top surface with longitudinal convolutions only, extending in straight lines from one section to the other; to do this quickly and without unnecessary sections is a matter of experience and visual judgment, requiring the personal attention of the engineer. The slope stakes should be marked on one side with the cut or fill and on the other with the distance from the centre line; some engineers also write the station (chainage) on the slope stakes. These stakes are put in at every 100 feet in light work and on tangents, but on curves and heavy work they should be put in every 25 or 50 feet, depending on circumstances, and on all side-hill work liable to slip the sections should be carried up the hillside 200 or 300 feet to points beyond any danger of movement, and should be taken before excavation has been commenced.

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

There are two methods of keeping notes in use in Canada; in the first, each rod reading is entered in a separate line and the corresponding cut or fill reduced from the grade elevation; in the second method the difference between height of instrument and grade is called "grade rod," and the rod readings are subtracted mentally from it, and the corresponding cuts or fills are recorded, consecutively, on one line of the book in the form of fractions, with the distances from centre line as denominators. It is evident that the first method is more laborious and fills much more space in a note book, and is not so convenient for plotting, but, on the other hand, the reductions can be checked afterwards, and are legal documentary evidence, whereas the second method is entirely one of convenience and leaves great chances for error by careless mental subtraction, which cannot be duplicated, and the note books are, therefore, not very strong evidence in a law court.

*Plate XXI*

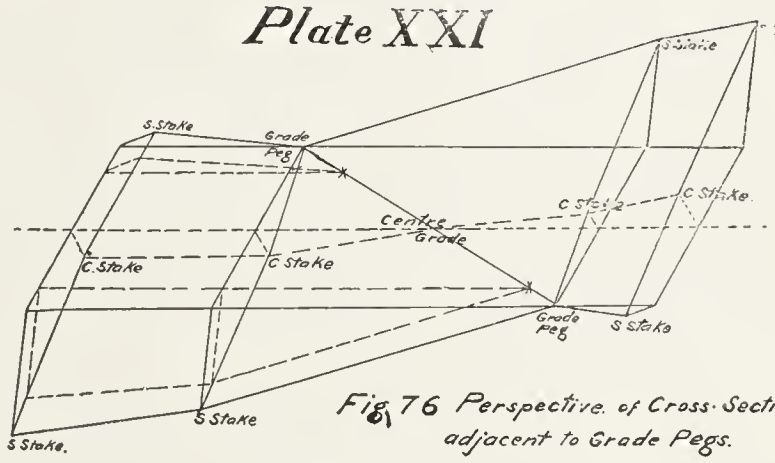


Fig. 76 Perspective of Cross-Sections adjacent to Grade Pegs.

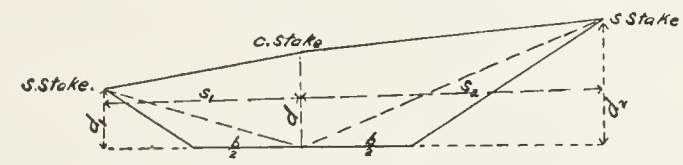


Fig. 77 Ordinary Three-level Section.

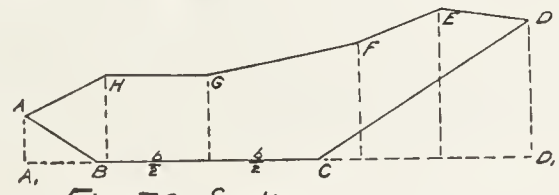


Fig. 78 Section on uneven ground.

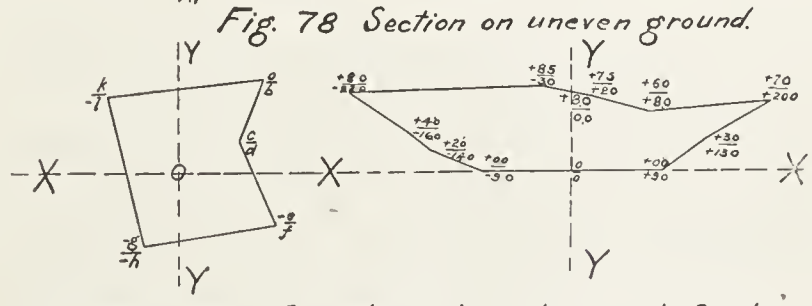


Fig. 79 Eckel's Formula with application to Sections.

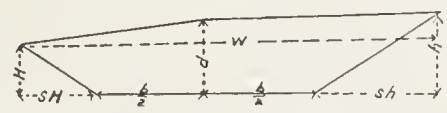


Fig. 80 Prismoidal Formula Diagram.

The following are notes of surface levels of Figure 80 taken by both methods:

(I) ENGLISH METHOD.

| Station. | B. S. | H. of I. | F. S. | Int. S. | Ground. | Grade. | Cut. | Fill. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| 102.... | .. | 311.20 | .. | 10.2 | 301.0 | 293.0 | 8.0 | .. | .. |
| 2 R.. | .. | .. | .. | 10.7 | 300.5 | .. | 7.5 | .. | .. |
| 8 R.. | .. | .. | .. | 12.2 | 299.0 | .. | 6.0 | .. | .. |
| 20 R.. | .. | .. | .. | 11.2 | 300.0 | .. | 7.0 | .. | S. S. |
| 3 L.. | .. | .. | .. | 9.7 | 301.5 | .. | 8.5 | .. | .. |
| 22 L.. | .. | .. | .. | 10.2 | 301.0 | .. | 8.0 | .. | S. S. |

(II) United States Method.

| Station. | B. S. | H. of I. | F. S. | Grade. | Grade rod. | Left. | Centre. | Right. |
|---|---|---|---|---|---|---|---|---|
| 102... | ... | 311.20 | ... | 293.0 | 18.2 | (s.s.) $+\frac{8.0}{22.0}$ | $+\frac{8.5}{3.0}$ | $+\frac{8.0}{0.0}$ | $+\frac{7.5}{2.0}$ | $+\frac{6.0}{8.0}$ | $+\frac{7.0}{20.0}$ (s.s.) |

The greater simplicity and convenience of the second method commend it to general use in spite of its drawbacks.

On some roads it is customary to take sections after the work is done, and pay for the actual quantities excavated; in others, the slope lines are adhered to and every endeavor is toward the full section taken out. It is probable, however, that the former method is more satisfactory to all concerned, although giving a little extra work to the engineering staff.

Structures need to be staked out twice, once for the foundation pit and again for the laying out of masonry, and of course, on all important structures, measurements and levels are given very frequently as the work progresses, both as an aid and a check to the contractors. A separate note book called a "structure book" should be used, and in it recorded, from day to day, notes of actual sizes, heights and measurements of all structures, and a duplicate office copy also kept up to date for fear of losing the field book. This structure book should include notes on all timber, stone and iron structural work, and will be a valuable aid in case of disputes involving quantities, it will also enable a large scaled profile being made for the maintenance department showing the exact chainage and elevation of each foundation and portion of structure. The necessity for absolute accuracy in laying out, measuring and calculating the quantities in all structures and grading cannot be too firmly impressed on the young engineer; all office calculations should be done in duplicate and preferably by different persons, as one cannot be very sure of a check on one's own work.

*Cross Section Areas* may be calculated in at least three or four ways, (1) where only a three-level section is taken, as in Fig. 77, the area of the section is evidently made up of triangles and is:

$$\text{Area} = \left(d \times \frac{S_1 + S_2}{2}\right) + \left(\frac{b}{2} + \frac{d_1 + d_2}{2}\right) \ldots\ldots\ldots (1)$$

(2) On rougher ground where more than three surface readings are necessary this method fails and must be replaced by more tedious ones, quite ordinarily Fig. 78 illustrates the one adopted, and consists in taking out the sum of all the trapezoidal areas, $A.A._1D._1D.E.F.G.H.A.$ and deducting the area of the two triangles $A.A._1B.$ and $D.D._1C.$

(3) By careful plotting, irregular areas can be taken out quite accurately with a polar planimeter.

(4) By Eckel's formula, which can be used without plotting the sections, and is equally adapted to the easiest or most difficult rectilinear areas. This formula, which is mathematically correct, is: "If the corners of any rectilinear polygon be referenced by rectangular co ordinates to any origin, then if the ordinate of every corner be multiplied by the abscissa of the next corner, and so on around the polygon, and these products added together; and if the ordinate of every corner be again taken and multiplied by the abscissa of the next corner, passing around the polygon in the *reverse* direction, and these products added together, then the area of the polygon is equal to one-half of the difference of these two sums." As an example, in Fig. 79 the area of the polygon is

$$\tfrac{1}{2}\{[(a \times d) + (c \times f) + (-ex - h) + -g \times -l) + (k \times b)] - [(a \times -l) + (k \times -h) + (-g \times f) + (-c \times d) + (c \times b)]\} \ldots\ldots\ldots (2)$$

or,

$$\tfrac{1}{2}\{(a \times d) + (c \times f) + (c \times h) + (g \times l) + (k \times b) + (a \times l) + (k \times h) + (g \times f + (c \times a) - (c \times b)\} \ldots\ldots\ldots (3)$$

In which great care must be taken to use the correct plus and minus signs. In railway work, this is much simplified by having all the area above the axis $XX.$, and in very irregular areas, which are met with in cuts that have slipped in as in Fig. 79, the area can be quickly taken out, thus, as follows:—

| Section = | $+\frac{8.0}{-22.0}$. | $+\frac{8.5}{-3.0}$. | $+\frac{8.0}{0.0}$. | $+\frac{7.5}{+2.0}$. | $+\frac{6.0}{+8.0}$. | $+\frac{7.0}{+20.0}$. |
|---|---|---|---|---|---|---|
| | $+\frac{3.0}{+13.0}$ | $+\frac{0.0}{+9.0}$. | $+\frac{0.0}{0.0}$. | $+\frac{0.0}{-9.0}$. | $+\frac{2.0}{-14.0}$. | $+\frac{4.0}{-16.0}$. | $+\frac{8.0}{-22.0}$ |

Area $= \frac{1}{2}\{-24.0 + 16.0 + 60.0 + 120.0 + 91.0 + 27.0 - 32.0 - 88.0 + 128.0 + 56.0 + 18.0 - 60.0 - 56.0 - 12.0 + 24.0 + 187.0\} = 227.5$ square feet.

Thus arriving at a correct result without plotting sections, and by a mechanical sort of process, which is a safe one to place in the hands of a comparatively unintelligent rodman; for the purpose of checking calculations, it is not appreciably more or less rapid than by taking out areas by method. (2)

### Quantities.

The use of tables and diagrams is a great aid in taking out approximate quantities, so that in various handbooks may be found the volume of 100 foot prismoids of level sections, of various heights, slopes and widths of road-bed, and this has been extended in Wellington's earthwork diagrams, etc., by giving the volumes of 100 foot prismoids where the sections, although not level, are of the three-level type, having a separate height at the centre and each slope stake, and as in easy sections this is all that is taken the diagrams are very useful. More accurate calculations of volumes of excavation or embankment may be made in three ways: (1) The prismoidal formula, which is the only one that is mathematically correct, is as follows:—

$$\text{Volume} = L \times \frac{A + 4A_1 + A_2}{6} \ldots\ldots\ldots (4)$$

Where $L$ = length of prismoid $A$ and $A_2$ = end areas and $A_1$ = middle area (which must be calculated by interpolating the middle heights).

A proof of this formula may be found in any mathematical text book, but a neat adaptation of the formula for three-level sections is given by Mr. G. H. White in *Engineering News*, April, 1895 (see Fig. 80).

$$\text{Volume} = \tfrac{1}{6} L\left\{A + 4A_1 + A_2\right\} =$$

$$\tfrac{1}{6} L\left\{\left(\frac{W.d}{2}\right) + \left(\frac{b}{2} \cdot \frac{H+h}{2}\right) + \left(\frac{W_2.d_2}{2}\right) + \left(\frac{b}{2}\frac{H_2+h_2}{2}\right) + 4\left[\tfrac{1}{2}\left(\frac{W+W_2}{2} \cdot \frac{d+d_2}{2}\right) + \frac{b}{2}\left(\frac{\frac{H+H_2}{2} + \frac{h+h_2}{2}}{2}\right)\right]\right\} \ldots\ldots (5)$$

$$= \tfrac{1}{6} L\left\{\left(\frac{W.d}{2} + \frac{W.d}{2} + \frac{W.d_2}{2}\right) + \left(\frac{W_2 d_2}{2} + \frac{W_2 d}{2} + \frac{W_2 d_2}{2}\right) + \frac{b}{4}\left(H + H_2 + h + h_2 + 2H + 2H_2 + 2h + 2h_2\right)\right. \ldots\ldots (6)$$

$$= \tfrac{1}{6} L\left\{W\left(d + \frac{d^2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}b(H + H_2 + h + h_2)\right. \ldots\ldots\ldots (7)$$

and if we have a definite slope which we call $s$. (say $1\frac{1}{2}$ to 1 for earth, or $\frac{1}{4}$ to 1 for rock), we will have

$$H + H_2 + h + h_2 = W + \frac{W_2 - 2b}{s} \ldots\ldots\ldots (8)$$

and the volume equation becomes

$$= \tfrac{1}{6} L\left\{W\left(d + \frac{d_2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}\frac{b}{s}\right.$$
$$(W + W_2 - 2b) \ldots\ldots\ldots (9)$$

from which it will be seen that the volume may be obtained by having the slope stake distances of the two end sections ($W$ and $W_2$), the centre cuts ($d$ and $d_2$) the roadbed width ($b$), and slopes ($s$), thus eliminating the determination of the middle area from the calculation.

(2) Mean areas, which custom has established as the one to be ordinarily used, because of its simplicity, is merely, volume $= L \frac{A+A_2}{2}$ .....(10)

where $A$ and $A_2$ are the two end areas, the error involved in this formula is $+\frac{1}{6}L\,(h-h_2)^2\,s$. Where $h$ and $h_2$ are the two centre heights, and $s$ = slope of earth work, it is evidently = zero when $h=h_2$ and increases with their difference.

(3) Middle area volume is given by

Volume $= L+A_1$ .....(11)

Where $A_1$ = area of section midway between the ends of the prismoid.

The error involved in this formula is $+\frac{1}{12}L(h-h_2)^2s$, being one-half as much as in the formula for mean areas, and also disappearing.

When $h=h_2$—and although equation (11) is more accurate than equation (10), it is not used, because once the middle area has been determined, the prismoidal formula is easily applied and still more accurate. There is another reason why formula (10) is not objectionable, that, in general, the profile of a line is convex in cuts, and concave in fills, and any system of sections, no matter how carefully taken will, as an average, need a little allowance for this rotundity between sections.

At points where the cut changes to a fill there should be two grade pegs determined (see Fig. 76) and cross-sections taken at these points, this makes the first volumes in cut and fill always pyramidal, there is no necessity for a centre grade peg, unless the distance from one grade peg to the other is excessive.

Borrow pits should be carefully cross-sectioned from some well defined base line before excavation is permitted, and, if at all possible, it should be made imperative that these pits before being abandoned should be left in good shape for final cross-sections and for drainage; undrained borrow pits are unsightly, a menace to health, and difficult, often, of measurement. There is another matter in this connection which should be well attended to, *i.e.*, proper referencing of alignment hubs; this may be done by cross lines fixed by hubs, trees, etc., or by right-angled lines and steel tape measurements, but in whatever way accomplished, considerable judgment is required to place the references out of harm's way and at the same time reasonably available; in side-hill cross-sections made after excavation great precision is required in this respect to prevent serious error.

### Article 29.—Methods of Payment and Classification of Materials, etc.

There are occasional instances of railway companies of some financial strength and progressive growth carrying on construction under their own management, with their own plant and by day labor, but such instances are not frequent, and in general we may look to responsible contractors for the rapid execution of this kind of work requiring experience, undertaking risk, and with considerable capital as plant continually wearing out. Occasionally such work is taken by contractors at so much per mile, within limits of curvature, grades, style and locality, but as the element of risk is great the price is correspondingly high. Only approximate estimates are furnished, and the experienced judgment of the contractor to size up the class of material to be met with is his chief reliance. Such contracts are apt to be made when the railway company and the contractors are more or less identical.

Again, at times, contracts are taken in which such as timber, stone and iron are specified as to quality and price *pro rata*, but the excavation is unclassified and an average price per cubic yard is given, the contractor again taking chances, and being, by this method, unable to alter the location, his risk is great and price high enough, on the whole, to cover the risk; this has led to what is, at present, the general method of letting contracts for excavation, namely, to define certain classes of material as rigidly as possible and fix prices for each class, the usual divisions are solid rock, loose rock, hard-pan and other cemented material, and earth. As the dividing lines between these classes are purely arbitrary they need to be defined for all possible contingencies, which is a difficult matter. An engineer is always, although in the employ of the railway company, more or less an arbitrator, and he should endeavor to be just to all; theoretically he should always live up to the strict letter of the contract, and ordinarily this is the only course to pursue, but there are cases in which contractors, in their eagerness to obtain contracts, take them at too low prices, or they may strike some very difficult cuts which will not classify very highly if the specifications are adhered to, and in such cases it is usual to allow percentage classifications based on a fair cost of doing the work, *e.g.*, a heavy cutting composed of a mass of small boulders closely cemented together would only classify as hard pan, but often must be excavated entirely by drilling and blasting, and in such a case percentages, at least of rock, would be quite justifiable.

This idea of *helping out* a contractor, however, is a very pernicious one, and should only be done for good cause, where the recipient is worthy of it by his economical handling of the work, and with full knowledge and consent of the railway company. The vigilant watch and full knowledge of the various classes of material met with in excavation and the most economical methods of handling them, form one of the most important duties that a railway engineer has to perform, needing, moreover, a knowledge of men as well as ways and means. The calculation of quantities in structures should be made very minutely and in detail, as the prices are so much higher per unit than those of excavation; but the method to be used will depend on the terms of the contract and the individuality of the engineer. In some cases payment is made on bills of timber furnished, and on general plans of masonry, while in others the actual timber used and the masonry as built are the basis of payment. In the case of timber this latter method should include payment, as timber delivered, for all pieces cut off either from piles or timber, so long as the material used was as per bill given.

Quantities of earthwork should always be measured in excavation, for no one can determine accurately the shrinkage of fills, especially as only a portion of it takes place while construction is in progress, and continues for a year or two depending on the method of forming the bank. The total shrinkage is fairly well known, being about 5 per cent. for sand, 10 per cent. for clay, and 15 or 20 per cent. for loam; while rock expands 50 to 75 per cent., depending on the size of the pieces, and such figures modified according to the age of the bank will be sufficiently accurate for monthly estimates, but not for final ones. It is more laborious, often, to measure irregular borrow pits, but by insisting on these pits being shaped up before being left, the extra labor is not so very great and is the only really reliable way, the chief value of embankment quantities being to aid in a proper dis-

tribution of material from cuts, to enable overhaul calculations being made, and for approximate estimates where errors of 5 per cent. or even more are not objectionable, as the company, in its monthly payments to contractors, reserves 10 or 15 per cent. for just such exigencies. In taking monthly estimates, the only certain method is to make each one a total estimate in fact as well as in name, and derive the current estimate by deducting the total one for the month previous from it, that is, never take notes only of what is thought to have been done during the month, for nothing is more difficult or more apt to lead to error—whereas if the total work done or material delivered at each point is noted, the errors of each month are eliminated in the next one—the extra labor involved in this is usually insignificant.

*Specification for Excavation.*—Materials excavated will be classified as earth, quicksand or dry hard-pan, loose rock and solid rock. Earth includes everything except the other classes mentioned. Hard-pan includes all cemented clay or gravel, or any combination of these that it is not practicable to plow with a four-horse team. Loose rock includes all stone containing not less than one cubic foot, and masses of detached rock containing not over one cubic yard; also all slate, shale or other soft rock which can be removed without blasting, although blasting may be resorted to. Solid rock includes all loose rocks containing over one cubic yard, and all rock in place which requires drilling and blasting.

(N.B—.The earth and hard-pan are sometimes placed in one class as earth, at a higher rate, thus saving much contention.)

ARTICLE 30.—SURFACE DRAINAGE.

In addition to the provision for flow of water under or through the track, there is yet the question of track and slope protection which is of almost equal importance. Where, on side-hills, the surface flow toward the top of the cut slopes and toe of the embankment slopes is considerable, ample provision should be made to intercept it. In general, catch water ditches three or four feet wide, and one to one and one-half feet deep, should be dug so as to run in a continuous line along the upper side of the cuttings and embankments from each lateral watershed to the nearest culvert or stream—which should set back five or six feet, generally, from the edge of the slopes leaving a solid berm; the material from these ditches, cast on the lower side will form an additional protection. In very porous soils, these ditches may need to be lined with pitch or planked; but in any case will prevent that heavy washing down of cut slopes which, otherwise, fills up the track ditches and floats the track, making the roadbed soft.

The track (cut) ditches themselves should be turned into these catchwater ditches at the upper grade points, so as not to empty down along the toe of the embankment, eating it away; and in very wet cuttings, it may be necessary to run a farm tile about three feet under the track ditches and parallel to them to aid the drainage. In case of quicksand, which will soon fill up tiles, the tile must be covered with straw and laid with collars, or longitudinal round pole drains may be substituted for the tiles.

The slopes of cuttings themselves also need protection to prevent erosion; in ordinary cases the sowing of grass seed on the slopes of cuts and fills will answer the purpose, but where the cut slopes are wet and springy it may be necessary, in addition, to cut a series of diagonal ditches on the slopes to bring the water to the cut ditches by easy grades; in extreme cases the construction of a network of tiles on the slopes may be necessary to effect complete protection. Perhaps the most imperative matter of all is to have the ordinary cut ditches always cleaned out—free from boulders, ties, ballast, etc., which tend to accumulate during maintenance. The form which such ditches assume is of a wedge shape, with a slope from the track of about 3 to 1 and an outer slope the continuation of the cut slope. This form will tend to maintain itself better than one with a flat bottom and steeper slopes.

(*Conclusion Vol. I.*)

*For* THE CANADIAN ENGINEER.

## SEWAGE DISPOSAL THROUGH THE ACTION OF BACTERIA.

BY W. M. WATSON, TORONTO.

Toronto and several other cities and towns, as well as private places, are contemplating putting in sewage works. Perhaps a little information, gathered from the leading bacteriologists, chemists and engineers, who have with the assistance of the best appliances been studying and experimenting on sewage for the past fifteen years, with the object of solving the knotty problem, viz., how to purify foul fluids, may be useful. My own experience in this connection will also be of interest.

Up to the present time precipitants of lime, powdered clay, alumina, ferrozone, sulphurous powder, sulphate of iron, and other chemicals, have been used to clarify or clean sewage by settling in tanks, generally extracting about a twentieth part of a pound of sludge per gallon of sewage treated, at a cost per head of population ranging from 25 to 75 cents, and often having considerable difficulty in disposing of the solids, even when expensive pumps, presses, and other machinery are used. The average composition of domestic sewage is: organic matter, 27.72 grains per gallon; nitrogen, 6.21; phosphoric acid, 1.17, and potash about 2.03 grains per gallon, which is principally in solution, and can only be removed by filters that contain numerous colonies of a very small rod-shaped bacteria that can be seen only by the assistance of a very powerful microscope. These organisms feed and thrive on the foul contents of sewage matter. Trade sewage may contain any chemical, and in some cases may need special treatment, which ought to be given it before it is allowed to enter the public sewers. Sewage heavily charged with grease may require a precipitant of bisulphide of carbon. Sewage from sugar factories which contains vegetable organisms, oscillaria alba, or beggiatoa, which act like ferments, rapidly decomposing, may require a magnesium chloride, quicklime and coal tar preparation, to extract its foul contents, and sewage from slaughter houses should have the blood and fat extracted before entering the public sewers.

To discharge clarified sewage that has only passed through settling tanks into fresh water is simply undoing the work done, because the dissolved putrefactive matter is held in solution after the solids are thrown down by the precipitants, and after being delivered into fresh water the dangerous microbes increase rapidly, and putrefaction is set up. Almost the same end is reached by allowing the sewage to enter fresh water after it has been carefully screened through a fine sieve, and it is probably more to the advantage of the public to allow sieved sewage to go in raw, than after it has been settled by the use of precipitants, because precipitants add somewhat to the chemicals held in solution, and make the sewage harder to purify.

Sewage placed under a microscope shows various decaying matters, multitudes of dangerous microbes, amoebiform bodies, infusoria, fungi, etc., including all the classes discharged from the skin and intestines of man and the animals. When water carriage is used to remove

excrements, it is usual to calculate upon a basis of about 156 lbs. of solids and 200 gallons of liquids from each one thousand of population to remove daily. The sewage from clothes washing is very dangerous.

Disposal of sewage by broad irrigation over the top of land is neither efficient nor profitable in cold climates, because it takes a large space, and only about two gallons per yard per day can be put on, even when vegetation is active, because of the tenacity of the soil in holding moisture. Vegetation only takes up the manurial deposits, and the bacteria in the land must extract the foul gases or poisons, which they cannot do when the air cells of the earth get choked with fat and dirt. Then the bacteria cannot secure aeration, and so becomes useless. During heavy rains and hard frosts, the land is totally worthless as a filter or absorber of foul matter. When either irrigation land or artificial filters become water-logged too long they become asphyxiated, the organisms cease to act and oxidation is suspended until air can again be introduced to the filtrate to give vitality to the bacteria. On that ground irrigation through land can only be a success when the position is high and dry, and the water can freely escape at a depth of over four feet, and when it is composed of sand and gravelly soil. Under these circumstances, it will act as a bacteria filter, and can be made to purify sewage all the year round, by laying perforated pipes about every two feet, so that the fluid will be evenly distributed over the land. The pipes may be laid about fifteen inches below the face of the land, out of the reach of the frost in winter, and out of sight in summer, to prevent any nuisance, and to allow the land to be cultivated. By so doing, the moist air rising from the sewage will aid the vegetation growing on the surface. When this system is adopted proper arrangements must be made to discharge the sewage through the pipes at stated periods and equal quantities, giving the land periods of rest and sufficient time to secure aeration, and to supply the air to the underground pipes, flues and air circulating shafts must be constructed so that every part of the irrigating land, gravel and sand, also the microbes lodging in it, may be sufficiently supplied with oxygen. A firm in Ireland mix a solution of soda with the sewage, which it is claimed gives the bacteria all the oxygen they require without wasting time aerating. This is described elsewhere.

The marked success lately of the scientists has shown that all purification of foul fluids, whether accomplished by fresh water, by farm land, or artificial filters, is done by bacteria, and every method used to purify sewage must have proper provision made to supply these microbes with oxygen. By scientific management these friendly bacteria, which are humanity's scavengers, can be coaxed to eat up all the dirt and impurities in the sewage and discharge it into the atmosphere in the form of non-injurious gases, and by so doing saving the expense of handling the sludge.

This narrows down the art of cleaning foul fluids into being able to cultivate, to breed and use friendly microbes to advantage. When this is accomplished and the ditritus screens, the preparative storage tanks and the bacteria filters stocked with the friendly microbes and set in motion, it afterwards costs little to manage the treatment plant, for it can be made fully self-acting, only requiring the ditritus removed from the screens, and the grit removed from the syptic preparing tank about once a year.

There are several sewage purifying works constructed on the system just described working at present, and it will no doubt be generally adopted when properly understood. What is named the syptic tank, is placed underground and arched over, made air-tight and kept dark. The town's sewage goes in at one end and is almost motionless for a day, and during that time the coarser particles in suspension become deposited, and the putrefactive bacteria contained in the sewage are disintegrated, and a large portion of the inferior microbes disappear along with the sediment, after which it overflows over the opposite end, and is passed on to the bacteria filters.

Where convenient, towns should have separate drains for the collection of sewage, and they ought to be divided into small districts, each having its own sewage works. By adopting this plan only small main sewers would be needed, a better grade could be given, the sewage would arrive at the works in a fresher state, and on that account would be easier to treat, it would not have time to putrefy in the pipes, and the sewers would not need so much flushing, and the large trunk sewers might be dispensed with. By the new method of sewage purification the district plan can be easily carried out, because the whole sewage plant can be placed underground in public squares or other convenient places, out of sight and totally free from smell or nuisance, there being no machinery required or sediments to remove, and the first expense of plant will be less than by the old systems, and the cost of management after the system is put in full working order will be very small.

When proposing to lay down a sewage disposal plant there need be no stereotyped rule, nearly every place will require a little different method of arrangements in detail. The difference in the composition of the sewage, the geographical position and surroundings, and the amount of depth applicable, will each need to be considered in the style of construction. The general points to be secured are, first, that when a filter is started it must be stocked with sufficient colonies of the friendly bacteria ; second, see that they are supplied at short periods with plenty of oxygen by a thorough aeration of the filter ; third, never allow the filter to empty with a rush, because in that case some of the bacteria would be washed out of the filter. Rush the sewage on as quick as you please, but draw off the effluent slowly. Never allow the filter to be water-logged longer than the microbes can exist under water on the store of oxygen that is in the air cells of the filtrate and the little there may be in the fluid. Where possible to secure carbon made by carbonizing towns' garbage, use it for a filtrate. When these instructions are adopted the plant may be made to any design and placed in any position, either open or buried underground, and the results will depend on the amount of scientific management and good workmanship introduced into the construction, as to whether 200 or up to 500 gallons of sewage per superficial yard of filter space can be run through each day.

I have already described the preparatory settling tank into which the sewage first enters for treatment after being freed of all ditritus. The bacteria filter that purifies the fluid is simply a separator, that divides the sewage into small particles, and also constitutes a residence for the millions of bacteria which are brought into contact with each particle of sewage, on which they feed and from which they extract the foul gases. Any handy material that is easily wetted and easily dried and cannot be dissolved by chemicals, will answer for the filter, because it is not so much the nature of the filtrate, as it is the size, the thickness and the arrangement of the material in the filter, that is of the first importance. The best material is that which contains the largest amount of air cells to the cubic inch, in which the oxygen can be stored when the filter is getting aerated. Carbon is preferable because it is a better non-conductor than gravel, it also possesses the most air cells and is a natural deodorizer. Thus,

either charcoal, carbon made from garbage, coal, spar, marble or gravel chips, clinkers, slag, sandstone, gravel, coarse sand, hard burnt clay or cinders will answer to charge the filter with.

If there is about 20 feet of depth between the bottom of the outfall sewer and the high-water mark of the fresh water channel into which the clear effluent is intended to be discharged, a free hand can be used in the construction of the works to the advantage of the paymasters; but if there be only five feet between the two points, a plant may still be made to work without the aid of pumps or other water lifting machinery. In places where there are combined storm-water and sewage sewers, it is unnecessary to treat sewage when a violent rainstorm is on, except that portion which is forced forward at the first rush, and which is really the scourings of the drains, because when 25 per cent. of sewage is well mixed with 75 per cent. of fresh water it becomes harmless, because the bacteria that are always in fresh water are in the ascendant, and will devour the small amount of foul matter the sewage contains. But when sewage is emptied into fresh water without being properly mixed and shaken up, it holds itself apart, and the *bacillus coli communis* and fecal microbes rapidly breed and thrive with the help of the adjoining fresh water, and resist the attacks of the scavenger bacteria by keeping in a compact body.

Filters can be constructed so that a constant current of air will flow through the body of the filtrate, simultaneously with a flow of sewage continually passing on and downward through the filtrate; and where the space is limited and room for a syptic tank cannot be secured, then in place of the dark syptic tank an upward flow roughing filter composed of crushed clinkers will answer for the preparatory process.

I have recently received the plans of a very simple and inexpensive mode of purifying sewage that is continuous in action, and requires no sieves, or screens, or any attention. If the sewage is weak because storm water gets a little mixed in, it goes through a little quicker to make up for it. It is well understood that it is the top twelve inches of a filter that does the work, and that there the bacteria slime rests because it is there where the air can be got the easiest, so the inventor forces the sewage in at one end of the filter and it moves along under the surface to the other end and passes out, thus the bacteria can secure air from the dry surface at any time.

There are a great many expensive sewage-disposal works now in use that discharge their finished effluents in a state that cannot be purged of the putrefactive matters that are held in solution, and that contain many colonies of active and dangerous microbes. These impure effluents are either discharged unfiltered, or are passed through filters which are rendered useless by the fact that they are never aerated.

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*For* THE CANADIAN ENGINEER.

## THE OXYGEN SYSTEM OF SEWAGE PURIFICATION.

BY W. M. WATSON.

The Sewage Purification Company, of Dublin, Ireland, has been good enough to send us a small pamphlet explaining their patented system of purifying town's sewage. There are several new features in the process worth noting. The company tells us that they use extra deep settling tanks, with sumps to collect the sludge, that they use baffle plates to throw down the solids, and that they supply the micro-organisms with the necessary oxygen they require by the use of nitrate of soda in place of and as a substitute for atmospheric air. They say that the oxidation of sewage is brought about by the operations of micro-organisms, and that the organisms which live on dead organic matters will quickly multiply in sewage, and will rapidly set up an oxidation of the organic matter it contains, making the sewage harmless if there is a regular and continuous supply of oxygen to all parts of the liquid under operation sufficient to sustain vitality during their life processes; and the sewage is preserved until acted upon in a neutral or slightly alkaline condition, and continued so during the activity of the organisms. When these conditions are maintained, several chemical changes take place. When the sewage passes through the first or roughing tank, the heavy solids are extracted; when passing through the second settling tank, the sewage, by the help of a precipitant, is converted into ammonia carbonic acid and water; and by the third and last process the ammonia is turned to nitric acid by microbes or bacteria. They say that they have succeeded in estimating the amount of air the microbes require to perform their work well. Thus, for very foul sewage, it takes 1,400 volumes of air to 1,000 volumes of fluid to remove the suspended matter, and even three times the bulk of air to one of fluid to finally and perfectly purify trade sewage. They point out that oxygen must be regularly supplied to the micro-organisms; if not, they will at once set up putrefaction, emitting offensive and dangerous odors. This would appear to mean that they hold that the intermittent method of aeration is a failure.

It will explain the remarks more fully by stating that the process of filtering is at present as far as sewage is concerned an artificial means of supplying the micro-organisms with oxygen. Therefore it is necessary to arrange appliances so that they will continually aerate every particle and item of the filtrate where the microbes that clean the sewage lodge. On this ground every description of filtrate must be open and porous, whether it be sand, crushed stone, clinkers, coke, fine pea coal or charcoal, and packed together in a way that will divide the sewage into small thin films that will move from one item to another on its downward passage through the filter, allowing the bacteria the filtrate contains to devour all the dead matter, also to allow a free passage of air to every particle of filtrate, so that the micro-organism it contains can be amply supplied with oxygen.

This so-called oxygen system consists of three processes, the roughing tank, then clarifying by a precipitant called manganese, often called Condy fluid, and the final process by the microbes, which are supplied with air or oxygen by the use of nitrate of soda without the help of filter beds, such as is described in the preceding paragraph, and that as thus far being in general use as a lodgment for the microbes and a medium for the circulation of air to supply them with oxygen.

The advantages of their system appear to be that by using nitrate of soda as a substitute for atmospheric air to supply the bacteria with the oxygen, they are able to sustain activity in a gradual and regular form, thus preventing any danger of the sewage setting up putrefaction during the process of purification. This, of course, assumes that oxygen can be properly supplied from nitrate of soda. The second advantage is that by using deeper tanks, baffle plates and nitrate of soda, they can keep up a rapid continuous flow through each of the three processes required, thereby purifying about 60 per cent. more sewage than can be done by other appliances used to mechanically purify foul fluids; taking only about one-third of space that other systems do for plant, having no expensive machinery pumps or fans, no tanks stand-

ing idle, aerating, etc. I approve of the idea of the deep tank and baffle plates; the soda business, also, if it is a genuine substitute for air, and can be efficiently applied at a small cost. I cannot approve the use of any precipitant, though manganese is one of the best precipitants that can be used, because the latest scientific experiments have proved that microbes and bacteria can totally destroy every impurity contained in sewage when properly aerated and housed in filters composed of powdered charcoal made from town refuse or small pea coal, and in a lesser degree by sand, small clinkers, stone and coke.

## SOME MODERN FORMS OF MILLING MACHINERY.*

FREDERICK T. SNYDER, KEEWATIN, ONT.

The time has happily gone by when directors of mining companies order a mill "ready made" like a suit of clothes, and it is not unusual to have a mill designed to fit the ore it is to treat, as carefully as the development aims to explore the lead. The machinery, whose description follows, is a case where designing to meet specific conditions has been carried somewhat further than is customary. The problem was to plan a custom plant to handle the gold ores of the Lake of the Woods, many of which are low in grade, but contain streaks of high values. The absence of copper or lead in addition to the low tenor, put smelting out of the question. A site was selected at Keewatin, having ample water power with the lake for a mill pond. The ore is brought in from the mines to the plant in barges carrying thirty tons. It was decided to build the mill, to unload this ore, crush it, and sample into storage, then run over amalgamated plates and vanners; all the ore handling to be automatic. It will be seen in the following description that nothing radical was introduced, and that the principal features worth noting were improvements in the detail of existing methods.

The ore is unloaded from the barges by means of a Locke-Miller cableway of four hundred and fifty feet span. This hoists the ore in skips to an elevation of seventy feet and carries it across the main line of the Canadian Pacific Railway into the sampler building. The skip is automatically dumped into a two hundred ton bin, by means of a spring hook. The bottom of this bin is shaped like the letter W, having a gate at each point, so that each side may be used as an independent bin. Both discharge into a crusher feed hopper in the form of an iron cone, thirty inches in diameter at the bottom, placed with the open end thirty inches from the crusher feed floor. The gates being open the ore forms a cone on the floor around the bottom of the hopper, and automatically works down as it is fed into the crusher.

This crusher is of the "Invincible" type. Tension strains are carried by wrought iron, and all compression strains by cast metal. The movement of the jaw is parallel, the top and bottom moving equal distances; and not, as in the Blake, where the bottom moves more than the top; or, as in the Dodge type of crusher, where the top has the greater throw. The usual arrangement is reversed and the outside jaw made movable, with the result that the common massive frame is done away with. This brings the weight of a ten-inch by eighteen-inch machine, which is the size used in this plant, down to nine thousand pounds, while the customary weight of the cast-iron framd machine of the Dodge or Blake type is from twelve thouse and pounds to eighteen thousand pounds. Each portion of the jaw moves over an elliptical path, the long axis of which is so inclined that during the moment of crushing the hanging jaw plate moves directly towards the stationary plate, and only at the end of the stroke moves down and back to feed the material through. The result is a minimum amount of cutting of the plates by the ore, there being no sliding movement at the time of greatest pressure. The tension strains are taken by four wrought rods, which run through the frame of the machine to the rear and end in nuts. By tightening independently the rods holding the top and bottom of the hanging jaw, the inclination of the moving plate with reference to the fixed one can be altered. It is profitable to have the opening of the crusher as large as possible, that sledging may be avoided, while the angle between the jaws must be so sharp that the rock will not jump up when the jaws come together. These independent adjustments allow the angle between the jaws to be the largest practicable for any particular ore, and once placed, does not change during the operation of the crusher. In the design of this machine the parts which require attention have been concentrated at the back, so that the jaw end can be built into the feed floor, placing the jaw opening where most accessible, and at the same time bringing together within easy reach and out of the dirt and dust from the ore all oil cups and adjustments requiring attention. The inertia effects in this machine were planned to make it as free as possible from longitudinal shake, and in this plant, where it is set twenty feet or more from the ground, produce little or no vibration of the building.

The ore from this crusher is carried by bucket elevator to a screen, which deserves especial notice, its use removing the list of troubles attendant on handling crushed quartz dry through a revolving trommel. It is an ordinary gravel screen, set up at an angle of forty-five degrees, and furnished with a cover. But it is this cover that makes the difference, as it prevents the ore from taking long jumps, and thus permits the use of a screen of almost double the mesh of the product desired. That is, to get half inch mesh ore use a one inch screen, the ore particle striking the screen at so small an angl as not to fall through if more than two-thirds the size of the opening. Particles of ore which get wedged in an ordinary screen do not get into the openings of this screen at all, but jump down over it to be further crushed. The screen surface used in this plant is five feet long and ten inches wide, and readily handles six tons of ore per hour.

What fails to pass the screen goes to a pair of rolls, in which the best results of the experience of a number of mining machinery designers have been utilized. These rolls having shells thirty-six inches in diameter and ten inch face, weigh twenty-six thousand pounds, and when taking rock from a three inch screen and crushing to half inch mesh, run smoothly without jar. The frame is cast in one piece, extended below to form a hopper. The moving roll is of the sliding yoke type. The bearings are nine inches in diameter by twenty inches long, and are patterned after the journals of a railroad axle, which seems to be the best type for heavy service under repeated strain. They have a solid shell and are babbited on the side supporting the strain. The other half is chambered out to form a recess to hold waste, soaked with oil. In addition, back of the babbit is cored out a water jacket, which, in the event of heating, can be connected by hose with the water supply, and the operation of the rolls continued. The shell on the outside is but partially formed in the shape of a ball and socket box. It allows the box to adjust itself to any horizontal angularity of the shaft, such as is produced when one side of the roll is fed an the other side is empty, but prevents the

*A paper read before the Federated Mining Institute, Montreal.

shell from tipping out of a horizontal plane so that the babbit in one end of the bearing cannot wear out without wearing out the other end at the same time. These bearing shells are supported in yokes, which, in the case of the movable roll, form the sliding part, and in the fixed roll are cast in the frame. By removing the caps of the yokes a roll, together with its bearings, can be lifted out at any time for repairs without disturbing the tension of the springs. One bearing of each shaft is furnished with collars on both ends, each of which, in the case of the ten-inch by thirty-six inch roll used in this plant, has a bearing surface of two hundred and sixteen square inches. Between these collars and the ends of the box are loose brass rings, making the total thrust bearing surface in each direction, on each shaft, four hundred and thirty-two square inches. These collars are threaded upon the shaft, and by screwing them in or out the shaft is adjusted endways to keep the rolls in alignment. The housing above is a prolongation of the frame furnished with openings covered with canvas curtains, making all dust tight. The shaft of the moving roll passes through sliding plates, which are held against the housing by springs. All the principal nuts on the machine are split and provided with clamp nuts, so that they can be securely held in adjustment, yet readily be loosened for movement. In operation, the rolls are set apart by means of cast-iron plates, against which the sliding box is screwed up solid. When running it does not jump. Each yoke of the sliding boxes has a bearing surface under it twenty inches wide by thirty-eight inches long, in the form of a steel plate two inches thick, removable when worn. To provide against the accidental introduction of a piece of steel too large to go through the rolls, safety springs are provided, which, however, do not yield until the pressure per lineal face of roll exceeds four thousand pounds, giving a spring pressure for this size of roll of forty thousand pounds, which will flatten out a wrought iron nut, but will allow a cold chisel to go through. The feeder for these rolls has no moving parts, but consists of a series of four inclined steps facing in opposite directions, from one to the other of which the ore slides, and is so spread evenly over the width of the roll shells. One of these steps is hinged, and by means of a short lever can be thrown up against the step above it to shut off the ore supply in case of trouble with the rolls or with the spouting above.

That portion of the ore passing through the screen goes to an automatic time sampler, which was designed for this plant. It consists of a casting about the size and shape of a miner's gold pan which is mounted to revolve on the end of a horizontal shaft. The ore to be sampled is allowed to fall on the inside of the sloping flange, and slides off into a receiving bin. At one point of the sloping flange is a narrow slot, which, as the sampler revolves, passes under the spout and allows a portion of the ore stream to pass through to the back of the sampler into a second bin, where it forms a sample of the lot. This sampler was designed to avoid the mechanical complication of the Bridgeman sampler, which was recognized as doing theoretically correct work. An attempt was also made to reduce the head room necessarily occupied by a sampler, with the result that the seven feet required for a Bridgeman sampler of the same capacity, has been reduced in this machine to twelve inches. It is probable that this machine, while making but one cut on the material, does theoretically the same work as the Bridgeman, which makes three.

From this sampler the ore drops into one of two three-ton hopper scales, where it is weighed and delivered by flat belt conveyor to one of the two hundred ton storage bins. When required for reduction it is drawn off from the bottom and carried by another belt conveyor two hundred feet into the stamp mill. These are flat belts, twenty inches wide, eight ply rubber, running at a speed of three hundred feet per minute, and have proved entirely satisfactory. The surface wears but little, the ore being given the same forward velocity as the belt, before it is allowed to drop upon it. This belt has carried over sixty tons of ore per hour on a space not over eight inches wide in its centre. The belt goes uphill and delivers the ore into the ore bins above the stamps.

From these it is fed by automatic feeders of the suspended "Challenge" type, which are without the usual frame and hopper, the disc with its rotating mechanism being hung on two iron bars at the back of the mortar. A light iron spout connects it with the ore bin gate, and the ore bin proper forms the hopper, thus giving free access both to the back of the mortars and to the mechanism of the feeder.

These deliver ore into the mortars, which were designed solely as crushing machines intended to give a maximum output when fed with ore which has passed a half-inch screen. They are double discharge, provided back and front with splash boards. The discharge from the back screen is carried through a channel cored out in the base of the mortar so as to issue, together with the discharge from the front screen, through a short spout on the front of the mortar. These mortars weigh six thousand pounds apiece, the base being ten inches thick. They are furnished with steel liners on the sides and ends, and the wear of the shoes compensated for by false bottoms of steel. The screens stand at an angle of seventeen degrees from the vertical, and are twelve inches by fifty-two inches, giving a total discharge area of twelve hundred square inches. The stamps dropping in these mortars weigh nine hundred and fifty pounds each, and drop eight inches one hundred times per minute.

The pulp passes from the mortar to the distributing box of a gyrating copper plate, four feet long and six feet wide. These are silver-plated, coated with amalgam, and by a simple mechanical arrangement each point in the surface of the plate is caused to gyrate around a circle about three-quarters of an inch in diameter. This causes each particle of ore, in place of running over a straight path of amalgamated copper six feet long, to go over a spiral path about thirty-four feet long, before it reaches the bottom of the plate. The gyrating shake enabling the table to be operated at about one half the incline necessary without it.

From these plates the tailings pass to vanners with four feet plain belts. These vanners, in place of the customary side shake of the "Frue," are given the same gyrating shake as the plates, that is, each point in the belt moves over a circular path about three-quarters of an inch in diameter. The reason for this circular shake in place of the customary side shake of the Frue vanner will be apparent to anyone who has attempted to settle the contents of a gold pan; or in a hand screen, has tried to get the coarse material on top. The advantage of this shake is so apparent, that the question arises, why it has not been used before, especially as it was patented some seventeen years ago in the United States. The difficulty has been to build a practical machine that would not shake itself to pieces under the varying strains brought about in producing this gyrating motion. Success was obtained in the vanners of this plant by stripping them of the customary heavy frame, supporting them on six round

steel rods, one end of which was screwed to the floor, the vanner resting on the upper end free to float around in any direction. The belt is stretched over rollers in the usual arrangement and below it is supported, on a short vertical shaft, an unbalanced weight. When this weight is caused to revolve by a two-inch belt the amount that it is out of balance causes the vanner to swing around in a circle, whose radius multiplied by the weight of the table equals the radius of gyration of the unbalanced weight multiplied by the amount that it is out of balance. In practice it has been found desirable to use a gyration about three-quarters of an inch in diameter, and to run the table at a speed of about two hundred and twenty-five shakes per minute. Owing to the fact that the table is just balanced by the amount the gyrator is out of balance, no jar or shake is transmitted to the floor, and no racking strain is set up in the vanner itself. The feed of the belt is obtained from a Challenge feed clutch on the head roll. The tail of this clutch is attached by a flexible link to a point on the floor, the gyration of the table furnishing the necessary movement. By changing the point of attachment of the link to the floor, the feed of the belt can be altered from nothing up to twenty-five feet per minute. The heavy frame of the Frue vanner, the side shaft with its three eccentrics, and the complicated "G" spring feed is avoided. From the vanners the tailings are divided over two more sets of gyrating copper plates, each four feet wide by six feet long supported in a similar manner on flexible steel rods, and gyrated by the revolution of an unbalanced weight supported below each.

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## THE D'ESTE AND SEELEY COMPANY'S STEAM TRAPS.

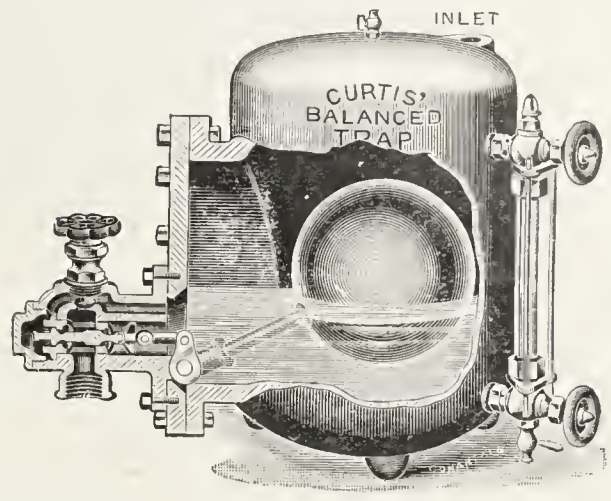
Every high pressure heating plant or any heating pipe not returning to the boiler should not be allowed to run a moment without a steam trap. No sane man would think for a moment of opening a pipe direct from his boiler to the atmosphere and try to get steam, and yet that is just what is done when a pipe is not drained by a trap. The amount of money wasted in this way on an ordinary steam plant in one season would pay for traps enough to last for years, and thus be one of the very best instruments which the owner or engineer could possibly make. While any trap is far better than no trap, it is always well to remember that a good trap costs little, if any, more than a poor one, and a purchaser with a little care in making a selection can assure himself that he is getting the best the market affords.

Four things should be required: First, efficiency; second, simplicity of parts; third, durability; and fourth, ease of making repairs when necessary. In all four of these points the Curtis balanced trap stands high, as may be seen by the following description:

The full prospective view shows a cylindrical pot with rounded ends, of the strongest form to resist pressure. On the side is a neck or nozzle of sufficient diameter to admit the float. This nozzle is covered with a strong plate, to which is bolted the composition valve. It will be seen that when the plate is removed it brings away the float and valve with it, which can be taken, altogether, to any suitable place to be examined or repaired, or can be shipped to the manufacturers, leaving the pot in place and connected.

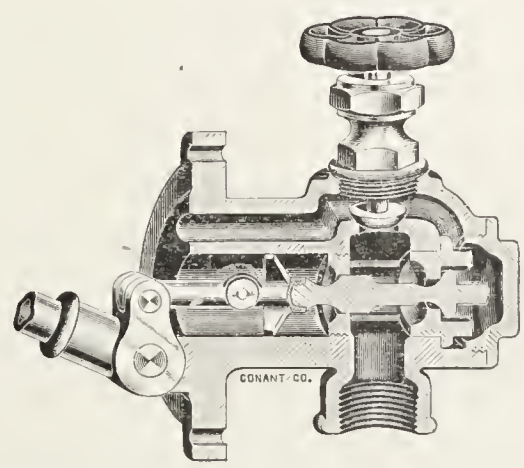
The composition valve can be removed without removing the cover, by taking out the four tap bolts by which it is fastened; then the float steam can be pulled out far enough to unscrew it from the knuckle, leaving the float inside and cover joint intact.

The sectional view shows a valve body cast with strong ears to bolt it on to the cover of the trap. The valve consists of two discs of equal area on a single stem, one with




a short sliding fit, and the other with a ground seat taper fit, which guides it onto its seat, while the valve stem is guided by a spider with three arms, and is loosely connected by a knuckle joint and stem to the float. The valve stem is in two parts, the outer one carrying the discs screwed into the inner one; and when unscrewed the valve can be taken out for repairs or grinding.

By removing the cap from the end of the valve body, the valve can be taken out without starting a joint, pipe, bolt or gasket. This is claimed by the makers as an entirely new, as it certainly is a valuable, form of construction. It is also provided with an independent passage or passby, and is the only trap, so far as known, with the valve so easily accessible from the outside. It is also provided with an independent passage or passby controlled by a stop valve, and work can be continued and the water drained off, even if the discharge valve should remain closed for any reason. The float is very large, perfectly rounded, so hard that it cannot be dented, nor can it be collapsed at 200 lbs. pressure. It is made by a special process of an alloy with aluminium, and is practically indestructible. It is hermetically sealed as a glass globe, and is so located in the trap that the outlet is always sealed by several inches of water.




These steam traps have acquired their reputation in the last eight years simply on their merits. This is presented as a strong, plain, serviceable machine, and is warranted to work correctly under any disadvantage to which a steam trap can be subjected. They will work against any head or back pressure less than the direct pressure in the trap. Some of them are now working with 75 pounds in the trap, against 30 pounds pressure on the outlet, and deliver hot water into the second and third story or into a closed tank.

The Curtis balanced trap is also often used as a water-line trap on large plants, when there is need to balance any particular circulation, to prevent snapping and cracking in the pipes and radiators. This is accomplished by connecting the direct steam-pipe to the top of the trap, and bringing in the return below the water line of the trap.

## MONTREAL ISLAND BELT LINE RAILWAY.

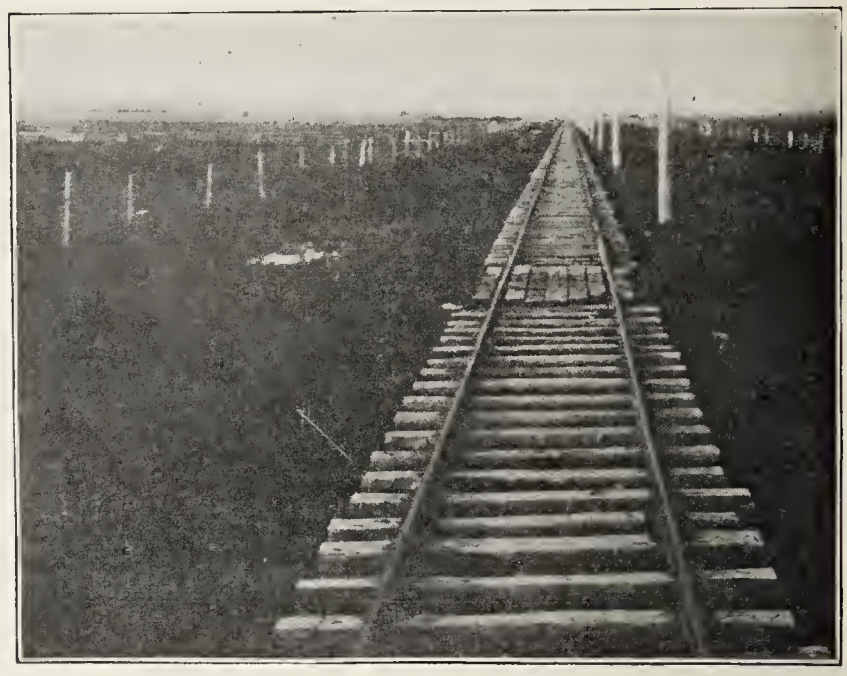
The Montreal Island Belt Line Railway, about thirteen miles of which was opened for operation during the past year, constitutes perhaps one of the most significant facts of recent years in connection with the development of the commercial capital of Canada. At the time the North Shore Railway was being constructed between Montreal and Quebec, great pressure was brought to bear upon the Government to bring it across the Riviere des Prairies at Bout de l'Ile, and thus traverse the Montreal Island to the city of Montreal. For reasons, apparently political, this influence was disregarded, and the North Shore Railway was brought into the city via St. Martin's Junction, thus adding fifteen unnecessary miles to the length of the line. The lower part of the Island, which comprises its best half, covering a distance of about thirteen miles, consequently remained in a large measure inert, until a year ago, when operations were begun by the Belt Line. This seems to be the beginning of the much-talked-of scheme to girdle the Island, a charter for which is held by the Belt Line Company.

In 1897 the old Belt Line Company was reorganized, new blood and large capital brought into it, and operations begun on a vigorous scale. Although the charter is for the construction and operation of either a steam or electric railway, the directors judged it in the interests of the company to make use of the latest developments of electricity as a motive power. The construction of the line was pushed rapidly forward in the face of great difficulties in the way of land expropriations, and the line was opened for traffic a little more than a year ago.

The line is thoroughly constructed, on the standard gauge, and specifications of the Dominion Government railways. It has its own private right-of-way, constituting a strip of land eighty feet in width, the whole distance. It is almost a straight line from one end to the other, and with the single exception of the Canadian Pacific Railway at Hochelaga, its gradients are practically level. The line leaves the Canadian Pacific Railway at Hochelaga, and passing near the proposed Inland Basin, traverses the municipality of Maisonneuve, Longue Pointe and Pointe aux Trembles. Where the line crosses La Salle street in Maisonneuve, an extension is built along La Salle street (one of the principal streets in the town) to Notre Dame street, crossing on its way the tracks of the Montreal Street Railway at Ontario street. St. Catharine street and Notre Dame street. The Town Council of Maisonneuve, alive to its own interests, secured this concession from the Belt Line Company by granting them a perpetual franchise of the street in question and exemption from taxation for a long term of years. In its course through the municipality, the line passes close to several large manufactories, to which sidings have been laid by the company. Passing through the municipality of Longue Pointe, it runs within a few hundred feet of the immense Asylum for the Insane, which is now in course of construction.

It may not be known by everyone that the extensive Longue Pointe Asylum, which has existed for many years near the banks of the St. Lawrence in Longue Pointe for the care of an unfortunate class of the community, is about to be removed to a more suitable location, about a mile and a half further back on the same property, where the buildings will be reconstructed on an immensely larger scale than ever existed before, and that to this end the Quebec Government guaranteed a loan of $500,000 at a low rate of interest. The buildings of the new asylum are in the course of construction, and when completed will constitute almost a town of themselves.

From Longue Pointe the line of railway pursues a perfectly straight course to Pointe aux Trembles, a most flourishing and attractive suburban village, situated about six miles from Montreal. Since the advent of the railway building, operations in the village have been very active, and there is every prospect of a most prosperous time for the village. From Pointe aux Trembles the line turns slightly to the left, and following the course of the St. Lawrence River, and in full view of it, it reaches Bout de l'Ile, a distance of another six miles, passing on its way the Catholic convent at Pointe aux Trembles, and the French Protestant Training School.



A Straight Bit of Track.

At Bout de l'Ile, where the cars are connected by a steam ferry with the town of Charlemagne and other points, a large park has been established by the company, covering more than twenty-five acres. Bout de l'Ile ("the end of the Island") is an ancient hamlet, beautifully situated at the "meeting of the waters," where the Ottawa (Riviere des Prairies), merges into the blue St. Lawrence. The company has transformed this dreamy hamlet into an ideal summer resort. Its charming grove of maples and elms has been turned into a picnic ground, and ample pavilions, band stand, boat-houses and bath-house put up. A bicycle track has also been laid out around the park, to form at no distant date an important feature in the plans of devotees of the wheel in Montreal. The large hotel overlooking the two rivers has just been purchased by the company, and plans have been made for a big extension, which is to be ready for occupation by the Queen's birthday. The idea is to provide first-class accommodation and harmless and amusing diversions for the citizens. The hotel grounds will comprise 330,000 sq. ft. of land, and the new building will have a dining-room 36x60 ft., and a billiard-room 20x50 ft. The grounds will have fountains, tennis lawns and croquet courts. That the susceptibilities of temperance people may not be offended, the bar will be kept away from the hotel building altogether.

The company, in equipping their line, made a new departure from what has seemed to be the established custom in Montreal. The cars placed upon the road are of the best description, finished inside and out of imported mahogany, oiled and polished. The cars, instead of being the orthodox one-truck, were equipped each with double Taylor electric trucks of the latest construction. Inside they are luxuriously upholstered and polished, while the unsightly stoves of some electric railways have vanished, and each car is heated with six electric heaters of the latest description. They are handsomely vestibuled at both ends, and brilliantly lighted. These cars can only be compared to Pullman coaches on a smaller scale. The open cars, so much appreciated by summer travelers, are likewise built and finished in the handsomest possible manner. They are forty-five feet long, also double trucked with the Taylor Electric trucks. One of the open 45-ft. cars is shown in the accompanying engraving.

The company has also placed upon its line an electric locomotive, built to handle ten loaded cars. This latter move was made in order to meet the demands of the trade in the lower part of the city, connections having been made with the tracks of the Canadian Pacific Railway. A satisfactory arrangement was made with the latter company and the Belt Line for switching the East End freight coming over the Canadian Pacific Railway and destined for points in Maisonneuve, Longue Pointe and Pointe aux Trembles, and the end of the Island, in car lots.

An electric rotary plow has been in operation all the winter, and has performed most efficient work. The snowfall of the past winter is well known to have been one of the most severe in the memory of man, and on the occasion of the most severe

of these storms, when all the steam railways in the country were tied up for three, four and five days at a time, the rotary plow of the Belt Line opened the line up from one end to the other inside of five hours. At places the drifts of snow were so deep that the upper part of the drift had to be removed to permit of the egress of snow from the machine as it was discharged in a continuous and rapid stream from the vents.

Double Truck Car.

The power-house of the company is built about half way between the two ends of the line, near the village of Pointe aux Trembles. It is situated on the edge of the St. Lawrence, and a wharf has been built at this point out into the stream. Two large car barns have also been erected, besides other minor buildings, and as this point is connected with the main line by a short branch of a few hundred feet, there appear to be excellent

Rotary Snow Plow.

facilities for ultimately bringing car-lot freight from Montreal, destined for shipment, and here transferring to the vessels. The company before deciding upon its equipment investigated all the latest improvements in electricity, and canvassed the various electric manufacturers in Canada and the United States. The decision arrived at, and what has been carried into effect, was to install three compound condensing Wheelock engines, aggregating over seven hundred horse power, belt connection, and two electric dynamos, one of 200 kilowat, and the other of 325 kilowat. The contract for the engines was given to the well-

A View in the Park.

known makers, Goldie & McCulloch, of Galt, Ont., and was carried out in a highly satisfactory manner to the railway company. The engines are models of perfection, grace and easy working. They are placed on massive masonry foundations, and when revolving at a high rate of speed, so slight is the vibration that a copper cent can be set upright on its edge on the curved surface of the cylinders and remain there indefinitely without being overturned. The engines are divided into three units, two of 150 h.p., and one of 435 h.p. By thus dividing the units, the power for every varying condition of traffic upon the company's line is made to correspond with the consumption of fuel. So economically are these engines built and graduated that during last year's operations the consumption of fuel, repairs to motors, engines, boilers and generators, all included, amounted to less than 2 1-3 cents per car mile. The makers appear to have surpassed their usual excellence of work. The contract for the large electric dynamos was given to the Canadian General Electric Company, of Peterboro, and has been filled in an equally satisfactory manner. These machines will develop as high as 900 h.p. between them, and their regular rated capacity is nearly 700 h.p. At times during the past summer work upon the line was very heavy indeed, notwithstanding which no defect of any kind discovered itself in these magnificent machines. The motors for running the cars were also obtained from the Canadian General Electric Company, and were placed two to a car. They average about 35 h.p. each, and are geared to run the cars at a speed of about 25 miles an hour. The motors have done excellent service. Twice since the opening of the line for operation, the company have been obliged to increase the number of cars and motors.

The car bodies were built principally by the Ottawa Car Company, of Ottawa, and the managers believe that in construction and finish they are unsurpassed by any electric cars in Canada. The number of cars now consists of four large open cars, 45 or 50 feet in length, and with a capacity of 150 to 200 people to the car; five shorter cars, and four closed cars, in addition to the locomotive. Several of these cars have been added quite recently, as the traffic during last season was so great as to frequently compel passengers to satisfy themselves wih standing room only. It is with a view of doing away with this inconvenience to their patrons that the company has lately increased its rolling stock. During the year past, which was the first year of opening, the company handled over 300,000 people, and it is anticipated that during the present year this number will be doubled.

The operating expenses of the road were only 62 per cent. of the gross receipts, notwithstanding the fact that much experience had to be learned, and that last season was unprecedently wet and cold. During the summer months the cars ran every ten minutes, and throughout the winter an hourly service was maintained. The operations of the company so far have given

The Old Horse Ferry.

such satisfaction to the public, as to support the belief among some railroad officials, at least, that it is best to conciliate and please the patrons of the road. Incredible as it may seem to outsiders, before this railway was opened, the lower part of the Island was in a worse position as regards postal facilities and

traveling accommodations for the public than many country districts a hundred miles away. The only means of communication was the old-fashioned stage coach, which ran daily between Montreal and Bout de l'Ile, plodding its weary way through mud or snow drifts, as the case might be, exposing its patrons to a drenching rain or a burning sun, and consuming from three to six hours in making the trip. The evening newspapers' issues to-day did not reach their subscribers until to-morrow night, notwithstanding that these seekers after knowledge were within twelve miles of the metropolis of the country. The communication with Charlemagne and the towns along the line, some of them of very considerable importance, including the large town of l'Assomption, at which there is one of the most noted educational institutions in the country, was restricted until lately to a peculiar construction called the "horse-boat." This craft was composed of two hulls placed side by side, and planked over, a stern wheel is slowly revolved by means of a pair of unhappy-looking horses working a tread-mill. The approach of the boat to either side was irregular, and usually depended upon the impulse of the officials in charge. There was not, however, usually any chance of the waiting traveler losing his boat, as its approach was heralded from afar by the clanging and rumbling of the iron cogs of the wheel connecting the tread-mill with the unhappy horses at the back. In stormy or windy weather the boat usually declined to make any trip at all. One of those quaint craft is still to be seen at Bout de l'Ile. It is probably the most primitive form of ferry-boat to be found on this continent. J. H. Bernard, of Montreal, informed a representative of THE CANADIAN ENGINEER that his grandfather used to cross the St. Lawrence by this ferry over 100 years ago, and it was doubtless in use long before his day.

Some time, no doubt, the railway will be extended across the river. Sixty years ago an enterprising farmer on the other side of the river constructed a bridge at this point over both channels of the Riviere des Prairies, aggregating about half a mile or more in length. The model of this old structure is still to be seen in the old dwelling-house of the time. It is an ingenious construction, and bespeaks a great degree of industry and no little ability in the maker. This useful structure, however (for during its life it was used by a great many people), was not long for this world. Some three years after its construction the high water of the spring and the ice carried it mercilessly away, and nothing remains to tell the tale beyond the approach on each side, and here and there the ruins of a sunken pier.

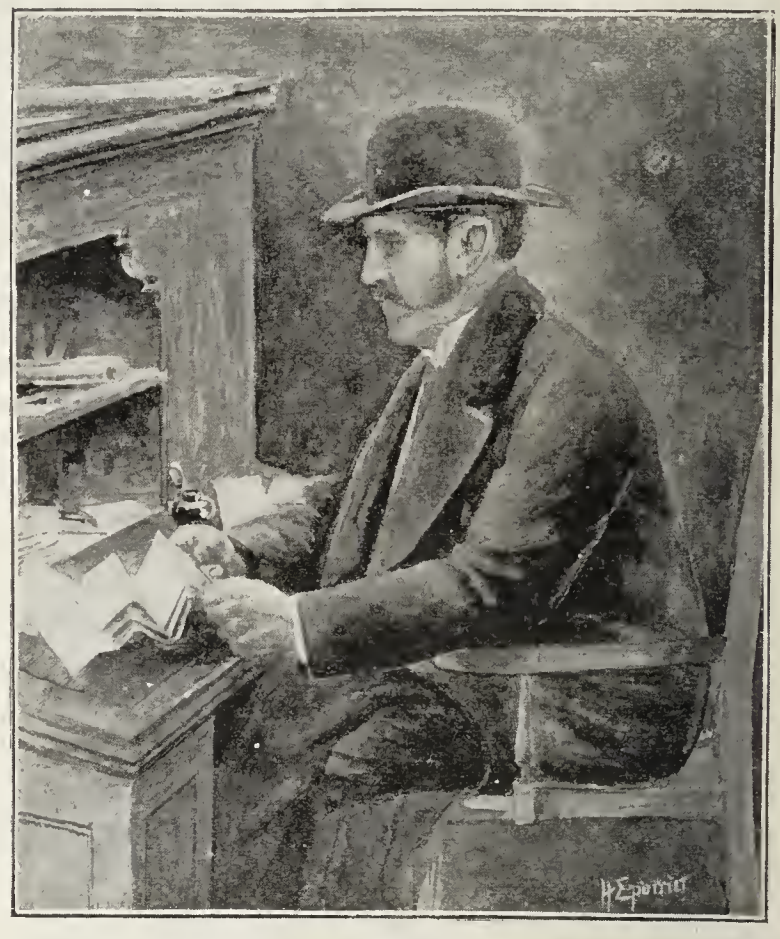
Since the opening of the railway the aspect of everything has been changed. The beautiful farm sites along the banks of the river have been laid out in building lots, and many cottages have been erected. Four rivers, known as the l'Assomption River, Back River, and Riviere des Prairies, the two latter being branches of the Ottawa, and the mighty St. Lawrence, all come together at Bout de l'Ile, hence this point has been fittingly named "Where the Waters Meet."

ROBERT WELSFORD, ENGINEER.

The Belt Line cars are always on time at the intersection of La Salle street and Notre Dame street, in Maisonneuve. One of the strict rules of the company is that the cars run absolutely on time. The point of starting is reached by the Notre Dame street line of the Montreal Street Railway. During the winter the Ontario street line of the latter company has been extended to the intersection of the Belt Line, and during the coming season Montrealers will doubtless find it both pleasanter and easier to reach the Belt Line cars without the trouble of making any transfer on the way. By this means a passenger can take the Montreal street car at Wellington street, and for four cents enjoy a trip of nearly seven miles in length, where he again proceeds another twelve miles to a charming park at the end of the island, and which is so large that even when four or five thousand people are scattered over it, there can be found a quiet retired corner for himself and his picnic surroundings.

The officials of the company are W. Dale Harris, late managing director of the Ottawa and Gatineau Railway Company; John P. Mullarkey, managing director, a railway man of considerable experience; John Rowley, superintendent; Robert Welsford, engineer in charge of engines and plant, and C. H. Wright, electrician.

Robert Welsford, engineer of the Montreal Island Belt Line



W. DALE HARRIS, PRESIDENT.

Railway, was born in Paisley, Ont., 35 years ago. As a boy he obtained his education under great difficulties, having been able to go to school only two years, but while serving his apprenticeship as a miller, he studied at night, and made good headway in his studies. He filled good situations as miller with such firms as A. W. Ogilvie & Co., Montreal; James Goldie, Guelph, and Robert Noble, of Norval. Owing to fail-

J. P. MULLARKEY, GEN. MANAGER.

ing health, he quitted the milling business, and afterwards, having a taste for engineering, he took instructions in mechanical and electrical work for one week, and with this short appren-

tieship he installed the first arc light plant in Mount Forest, ten years ago. Since then he has been steadily employed as an engineer. Mr. Welsford's aim is to produce horse-power with as little fuel and friction as possible, and in aiming at this he has never been in want of a situation, while at the same time he has been able to help more than one fellow engineer in time of need. Mr. Welsford is the inventor of a new oil filter and waste sewer, which has been in use for five months at the Montreal Island Belt Line power house, with the most satisfactory results. We hope to give a description of this device in an early issue.

W. D. Harris, president, and J. P. Mullarkey, managing director of the Montreal Island Belt Line Railway, were associated on the directorate of Pontiac and Pacific Junction and the Ottawa and Gatineau Railways. Mr. Mullarkey was first connected with the Belt Line Railway as managing director, which position he held for about a year, when he purchased the capital stock, reorganized the company, and induced Mr. Harris to become president.

JOHN ROWLEY, SUPERINTENDENT.

John Rowley, superintendent of the Montreal Island Belt Line Railway, is an old steam railroader, having been connected with the Midland Railway, Quebec Central, Quebec & Lake St. John Railway, Ottawa & Gatineau Valley, Pontiac & Pacific Junction Railway. He also put in the large new main water pipe from Lorette to Quebec city, eight miles, for the supply of water to the city, bridging the St. Charles with a tubular bridge. The stop gates and all connections to that system were done under his supervision. He took charge of construction on June 1st, 1896, of the Montreal Island Belt Line, and charge of the operating department Nov. 1st, same year. Born in the city of Quebec, 1861, went through the common school and took commercial course through the High school, Quebec, under the noted principal, Daniel Wilkie.

C. H. WRIGHT, ELECTRICIAN.

C. H. Wright, the Montreal Belt Line Company's electrician, started with the Renfrew Electric Company as trimmer and cleaner. He then engaged with the old Royal Electric Co., of Montreal, as dynamo tender in the alternating and power station, and later as wireman. He subsequently joined the Edison General on installation work. Returning to Renfrew, he installed and operated a three-wire alternating plant, it being the first of the kind in Canada. Leaving there, he worked at Peterborough for the Canadian General Co., then for the Kingston Street Railway, and finally constructed the Belleville Street Railway line. In 1892 Mr. Wright entered McGill University, from which he was graduated as B.A. Sc. in 1896, taking honors and leading in all electrical subjects of the third year. In the fourth year he led the electrical engineering graduating class, taking honors in four subjects, and making all the marks obtainable in electrical laboratory work under Prof. Callendar. Mr. Wright was vice-president of his class. He entered the employ of the Belt Line when the first rail was laid, and when operation started he was taken into the permanent staff as electrician.

## ACETYLENE GAS ON A CANADIAN RAILWAY.

The Pontiac Pacific Junction Railway Co. claim the credit of having the first express train in America, if not in the world, illuminated with acetylene gas. In conversation with Andrew Holland, of Ottawa, Wm. Ressman, superintendent of the road, suggested that acetylene gas would be a splendid illuminant for railway trains, if it could be safely handled. Mr. Holland expressed his firm conviction that it could be done with a Niagara Falls generator, if space in the baggage car were devoted to the purpose. Mr. Ressman at once placed two cars at Mr. Holland's disposal for the experiment. A twenty-light generator was installed in the baggage car. The cars were regularly piped for gas, with ordinary goose-neck drop fixtures. At each end of the cars the main pipe, ⅜, terminated with a hose cock, by which means the gas was piped between cars by rubber tubing. It was a hard time of the year for such a test, coming on the severe frost and storms of January. It was, however, a splendid success, so far as illumination was concerned. The light was as steady as starlight, bright and soft, so that passengers on the train could read the evening papers from any seat in the car with ease. The frost had no effect on the gas, and no amount of shunting could put out the lights. The disadvantages were: 1st, space occupied by the generator; 2nd, slopping over of the gas tank; 3rd, danger of causing slop and smell, should an explosion take place, where such a quantity of gas had to be generated, and trainmen with lanterns, pipes and matches always present; 4th, the putting out of the lights in the other cars when the baggage car had to be disconnected.

Mr. Ressman said if these difficulties could be overcome, acetylene gas, as an illuminant, had come to stay. It was cheap and effective. An idea suggested itself to Mr. Holland. that if small generators were coupled up in series to a main feed pipe, individual car lightning could be effected without any of the drawbacks complained of. The piping of the first-class car was slightly changed, five small generators, each 18 inches high, and 10 wide, were installed on shelves in a locker in the water closet. Mr. Holland felt confident that he had solved the problem. The first trip was a disheartening failure. When the train got up speed and the car began to rise and fall on its springs, out go the lights, and it took a box of matches to keep them re-lit. By the next trip, Mr. Holland had thought out a simple plan to remedy this defect, and the cars are now running with the lights in perfect order. Mr. Ressman has, in consequence, decided to equip both systems of railway, over which he has the management, with acetylene gas fixtures.

Mr. Holland's next experiment was with a locomotive headlight. The management of the Canada Atlantic Railway, ever alive to the improvement of their line, and the comfort, convenience, and safety of their patrons, placed a shunter engine at his disposal. The experiment proved the possibilities of acetylene gas as a headlight illuminant. Locomotive No. 26, of the Montreal express, was then temporarily piped ; for the headlight and gauge lamp, the postal baggage and express car were fitted up, and on Monday evening the express pulled out with the new light. Mr. Holland rode with the engineer, feeling anxious about the result, as the installation had to be put in so rapidly. The headlight was splendid, lighting up the entire right-of-way and far away ahead of the train. The terrific vibration of the locomotive did not affect it, but coming round a curve, a sharp rush of wind down the lantern ventilator extinguished the headlight, while the gauge lamp light, unprotected, was also blown out. The train was slowed down while the fireman went forward, re-lighted the jet, stopped the hole in the lantern with cotton waste, and the train proceeded without any further trouble. The postal car was so brilliantly illuminated that the clerks told Mr. Holland he would have to come with a revolver in both hands to take out his plant again. It is claimed that the system adopted by Mr. Holland is at present the only safe

way known to utilize acetylene gas where the generator is subject to vibration and is liable to come in contact with fire by accident or design. He deliberately explodes a generator without doing any more damage than causing a report like that of a toy pistol. The safety lies in the fact that only a very small quantity of gas is generated at one time. Railway men are taking a deep interest in the new light. Mr. Bailey, of the Railroad *Gazette*, of New York, came to Ottawa specially to investigate the system, and after seeing the generator charged and the train lighted, declared it to be the most simple and effective light for railways that he had ever investigated. The Government car "Cumberland" has been piped for gas and a plant installed. Mr. Schreiber is anxious to have the gas system thoroughly tested as to safety, as well as efficiency. It will be of interest to railway engineers to know that the locomotive headlight generator makes the run from Ottawa to Montreal on two pounds of carbide, costing three cents per lb. wholesale.

## THE YORK STREET BRIDGE, TORONTO.*

This bridge is at the foot of York street, Toronto, and gives access to the water front from the city for vehicles and pedestrians over the numerous railway tracks at that point As the bridge was built jointly by the city and the Canadian Pacific Railway, the plans were prepared by P. A. Peterson, chief engineer of the C.P.R. and approved by the City Engineer of Toronto.

The general design of the bridge is a steel trestle, composed of about 32 spans deck plate girder, ranging from 30 feet to 70 feet span, with wooden stringers and decks. There are also in addition two spans of less than 20 feet, rolled steel I beams. These girders and I beams rest on iron columns, standing on stone pedestals, except at the three ends of the bridge, where there are stone abutments. The width of the roadway, except on the southerly ramps, is 37 feet 6 inches, with sidewalks on each side 7 ft. 6 in. wide. On the southerly ramps the width of roadway is 32 feet 6 inches, with one 7 ft. 6 in. sidewalk. The ground plan of the bridge is "T-shaped," with the base resting on the south side of Front street, and it extends southerly therefrom, across the deviation of York street and the railway tracks to Lake street, a distance of about 906 feet. Here the ramps of the bridge turn, one to the right, and the other to the left, and descend to the level of the street. The length of these ramps is each about 316 feet, making a total length of bridge of 1,538 feet. From Front street the roadway of the bridge rises with a grade of one foot in twenty, for about 298 feet, and at the Lake street ends, there are similar falling grades of one in twenty, about 500 feet in length. Heavy loads to the railway freight sheds are taken over these grades every day, and no special difficulty seems to be experienced. There are in all three abutments and sixty-eight pedestal blocks. The foundations of the two Lake street abutments and all the pedestal blocks, except fourteen north of the south line of the old Esplanade, are on piles driven to the ledge rock. This was necessary, as this land was formerly part of Toronto harbor, and had only been filled in the year previously with miscellaneous rubbish, earth, brickbats, tin cans, as well as more objectionable refuse. When piles were to be driven, an excavation was carried down to one foot below zero level of the water of Toronto harbor, and soundings were then taken down to the rock. The piles were then cut off the correct length and driven home, with a "follower." Under the specifications, the piles were to be cut off one foot below zero level, and the above method was found less expensive than actually cutting them under water, and it was very seldom that a pile had to be cut when once driven home. Only a very blunt point was made on the pile, before driving. Four piles were driven for the small pedestals, eight for the medium and nine for the large pedestals. Under the abutments the piles were 4 ft. centres longitudinally, and 2 ft. 6 in. transversely. The excavation was then carried down six inches below the top of the pile and two feet in depth of concrete put in. In some cases where the underlying material was very soft, short lengths of two-inch plank were laid flat under the concrete, between the piles, in order to keep the concrete from settling on the soft material before it was set. The concrete foundation is 7 feet square under ten of the pedestals carrying the longer spans, 6 feet square under nine of the pedestals, 5 ft. 6 in. square under five pedestals, and 4 ft. 6 in. square under the remaining 44, and is generally two feet deep. The concrete was composed as follows, except when laid under water: Cement, 1 part, clean sharp sand, 3 parts, broken stone, 5 parts—all by measure. Under water the concrete was composed: Cement, 1 part, sand, 2 parts, broken stone, 5 parts. The cement used was the "Star" brand, made by the Rathbun Company, of Deseronto. Below ground the stonework is what is known as "rubble masonry:" above ground it is "rock-faced ashlar," and was built under the Canadian Pacific standard masonry specifications. The stone was brought partly from the contractor's quarries at Owen Sound, and partly from the Orangeville quarry. The contractor for concrete and masonry work was David Chalmers, of Owen Sound. The piling was done by the railway company's own men, and their track pile driver. The two top courses of the pedestals had to be drilled before being placed in position to receive the 1¼-inch iron rods which secured the iron columns to the masonry, and some little difficulty was experienced drilling completely through these stones without breaking them. This drilling was done with a steam drill, half from each side of the stone. The iron work was erected during the winter of 1896-7. It was supplied and erected by the Central Bridge and Engineering Co., of Peterboro', Ontario, and was paid for at so much per lb. in the finished work. The bridge was designed to carry in addition to its own weight the following live loads, either singly or in any combination: (a) 100 lbs. per sq. feet of roadway and sidewalk, (b) one 32,000 lb. road roller having a wheel base of 11 ft. 2 in. in length and 7 ft. 4 in. transversely, (c) a string of electric cars 26 ft. long, each weighing 30,000 lbs., fully loaded, on each track.

All parts of the structure were proportioned so that maximum loads should produce no greater tensile strain upon the net section than 12,000 lbs. per sq. inch. A wind strain of 400 lbs. for each longitudinal lineal foot, and 150 lbs. for each vertical lineal foot of the trestle bents was allowed for.

All steel had to come up to the following requirements:

| | |
|---|---|
| Ultimate strength | 58,000 to 65,000 lbs. |
| Elastic limit | 33,000 lbs. |
| Elongation in 8 inches | 20 p.c. |
| Reduction of area | 40 p.c. |

and was made by the open hearth process. Before leaving the shop it was thoroughly cleaned of all loose scales and rust with steel scrapers and brushes, and was then given a good coating of red lead mixed with linseed oil, well worked into all joints and surfaces, and after erection the ironwork was given two more coats of paint. All the timber in the deck of the bridge, with the exception of the sidewalk planks and paving blocks, is southern yellow pine, creosoted with 10 lbs. of dead oil of coal tar per cubic foot.

On top of the joists and 4-inch plank, were laid two thicknesses of best tarred paper, thoroughly sealed with roofing pitch to the planking, and each other. On top of this was laid the paving blocks, consisting of square-cut white pine blocks, 8 in. x 4 in. x 4½ in. deep, grain upwards. These blocks were held apart at the cross-joints by three specially-made nails driven into each block up to the collar, leaving the blocks 3-16 in. apart. All joints and vacancies were then filled in with best paving pitch, and the roadway covered ½ inch deep with gravel. A double track girder rail for electric cars was laid across the bridge by the Street Railway Company before the paving was done, for possible use in the future. The sidewalk planks are of tamarack, 7 ft. 6 in. long, 2 in. thick, laid with 1½-in. felt towards the kerb. The cost of the structure was approximately:

| | |
|---|---|
| Foundation and earthwork (including piling) | $ 4,200 00 |
| Stone and concrete work | 15,900 00 |
| Ironwork | 43,000 00 |
| Damages St. James' hotel property | 4,900 00 |
| Deck and roadways | 28,000 00 |
| Engineering | 2,000 00 |
| | $98,000 00 |

* Extracted from a paper read before the Ontario Land Surveyors, by A. P. Walker, of the City Engineers Staff, Toronto.

## ONTARIO LAND SURVEYORS.

The adjourned annual meeting of the Ontario Land Surveyors was held March the 8th in the repository of the association, in the Parliament Buildings, Toronto, the president, T. H. Jones, of Brantford, being in the chair. On this, and the two succeeding days, the meeting was occupied in hearing the reports of the various committees, and in listening to the reading of a number of very valuable papers by different members.

Extracts from some of these papers will be given our readers next month, as lack of space prevents us giving a full report of the meeting in this issue. The annual dinner took place on the evening of the 9th, and was a most enjoyable affair, being more largely attended than any previous dinner. The nominations of officers resulted as follows: President, P. S. Gibson, elected by acclamation; Vice-President, H. J. Bowman, elected by acclamation; Secretary-Treasurer, A. J. Van Nostrand, elected by acclamation. For Council of Management, in place of F. L. Foster and J. L. Morris, whose terms expired 1st of April, four candidates, F. L. Foster, J. L. Morris, Geo. Ross and Capt. W. F. Van Buskirk, were nominated. For auditors, A. W. Campbell and H. L. Esten, by acclamation. The president appointed as scrutineers of ballots Capt. K. Gamble and J. F. Whitson, who will, on the 7th of April attend the opening of the ballots by the secretary.

## STEEL CYLINDER PIERS.

*Editor* CANADIAN ENGINEER :

In the item in last issue of THE CANADIAN ENGINEER *re* bridge recently completed at Dundas, Ont., you say it is supported by steel "rail" piers. This should be steel "cylinder" piers. This is a small error, but I would not like anyone to think I would construct a pier of steel rails.

Yours very truly,

JNO. S. FIELDING, C.E.

Hamilton, March 12, 1898.

## MINING IN QUEBEC.*

BY J. OBALSKI, G.M.E.

The state of the mining industry in the Province of Quebec during 1897, is shown by the following notes, and is quite satisfactory, although there is no booming, for the present, on any of our minerals. I would mention copper and asbestos mining, charcoal iron-making as very important industries, with mica and chrome coming after, besides a few others which may become prominent later on.

### IRON.

The Radnor forges had its furnace in operation for the whole year, and the Drummondville, one since July. They have produced 8,386 gross tons of pig iron, 680 men being employed by this industry. The consumption of raw material has been 19,766 gross tons of bog ore, 2,545 gross tons of limestone, 1,031,800 bushels of charcoal. The quality of the product need not be mentioned. It is a credit to our country: in fact, it is highly praised, not only in Canada, but in the United States and Europe, competing with the best brands on either of the continents.

### CHROME.

This year, shipment has been 2,340 gross tons, mainly to the United States, and we have still in hand over 2,000 tons, about 60 men being employed. Our ore is mostly high grade, but I consider that with concentrating plants, we could use our low grade ore and the refuse of the mines, and considerably increase our shipments. This industry is in its infancy, but nevertheless, with only hand-working, we have taken out, since 1894, over 10,000 tons, representing an approximate value of $140,000, of which 8,183 have been shipped. I refer to a pamphlet I am just publishing on the subject.

### TITANIC IRON.

I would make mention of the discovery of important deposits in the Lake St. John district. People have also an eye on our magnetic sand, on the north shore, which may eventually become profitable to handle.

### OCHRE

Is prepared as in the past by two companies, in the vicinity of Three Rivers, with a production of 1,239 short tons of burnt ochre, which have been used in Canada, or shipped to the United States, 50 men being employed.

### COPPER.

Our low grade ores have been worked as usual, at Capelton, the product being 36,815 gross tons, of which 29,512 tons were shipped to the United States, a small cargo to England, and the balance used on the spot for sulphuric acid manufacturing, 270 men being employed. At Harvey Hill, some work has been done, but only 20 tons of high grade ore shipped. Several prospects have been made at a few points of the Eastern Townships, and the time may come when this industry will be one of the most important of this province, if we take into consideration the numerous good mines actually idle.

### LEAD, ZINC AND SILVER.

On the Calumet Island several good prospects have been made, showing the existence of an important mineral belt, containing zinc blend, and rich galena, carrying sometimes 200 ounces of silver to the ton. The Lake Temiscaming mine has also been worked to some extent, but no shipments made, and we may say that last year's output has been 430 tons of zinc blend, and 5,000 tons of galena, 45 men being employed.

### GOLD.

Prospecting was going on in the Beauce district, on the Gilbert, on the du Loup, and in Dudswell district, with also some finds reported in the vicinity of Sherbrooke. Besides those we know of, every summer, small parties find their living by washing in the rivers of our gold district. Some preparatory work has been done last fall on the old diggings of the Gilbert River, and according to recent informations, gold, in paying quantity, has been struck. I estimate approximately, that not more than $900 of gold have been taken out during the year. The question of the Beauce district has been discussed at length at previous meetings, and although not yet satisfactorily settled, I personally am fully confident in the final success of that region.

### GRAPHITE.

The graphite industry is one of the most difficult to operate advantageously in Canada, as we have to compete with old establishments in the United States, taking easily their supply from Ceylon. In the Buckingham district we have three companies with well equipped mills, two using the wet, and one the dry process, and it appears to me that their product is as good as any other one, and all that we require is a regular market for it. But little work was done last year, and we have not the account of the production.

### ASBESTOS.

The market for asbestos has been fair: three companies at Thetford, and one at Danville, employing altogether 800 men, have been in operation for the whole year, having shipped 12,565 tons of 2,000 lbs., of fiber, about 42,000 gross tons of the new product, called asbestic, have also been prepared, of which a very large quantity has been shipped, and the contracts made for the coming year will, it is expected by the company, take the entire output. Shipments have been made to England, Germany, Australia, South Africa, besides the United States and Canada. The Black Lake mines have not been in operation this year, and the production of two companies, having their mill in the Laurentian district, near Ottawa, was small, little work being done.

### PHOSPHATE.

No work done on this material, except a few hundred tons extracted from the mica mines.

### MICA.

Several prospects were made in the Gatineau district, but of small importance. In the vicinity of Perkins mill, in Templeton, three important companies have worked regularly, and taken out a large quantity of mica, well adapted for electrical purposes, of which a good part has been sold in Canada, and in the United States. It is very difficult to give exact figures regarding this mineral, on account of the numerous qualities and sizes, representing as many different prices, but according to the best informations, I estimate that about 200 short tons of thumb-trimmed mica have been taken out, 90 men being employed. I understand that the demand is less than previously, on account of the high duty in the United States, and that only the best grade of electrical mica is wanted. No mine of white mica has been worked last summer.

### PETROLEUM.

Prospecting and boring are going on as usual in the vicinity of Gaspe. Last season, some excitement prevailed on account of a larger quantity of oil being struck in one of the wells, which, in fact, has been flowing for some time. Nevertheless, nothing very definite has yet been ascertained. About 30 wells have been bored, some of them having struck oil in greater or less quantity. I am confident in the future of this district as an oil-bearing one, but the country is large, and its stratigraphi-

*A Paper read before the Federated Canadian Mining Institute.

cal structure not very well known. We don't know that any shipment of oil has been made, so far, except some barrels as specimens, and, in fact, there is not yet regular pumping done.

FELDSPAR.

In the vicinity of East Templeton Station, a quarry of feldspar has been worked with 15 men, for the whole season, the quantity shipped being 1,260 short tons. The material appears to be of a good quality, and is sent to the United States for ceramic purposes. A few other deposits of them, connected with white mica mines, exist, but are not worked.

KAOLIN.

I want to make a special mention of the discovery of this material in our province. In 1894 I visited the township of Amherst, Labelle county, and my attention was called to a white material, which, after testing, I was able to pronounce to be a genuine kaolin. The indication was a small one, but may lead to the discovery of an extensive field of said material. Subsequently R. Lanigan, from Calumet, secured some property there, made some prospects, and came to the conclusion that workable deposits existed. He also sent specimens to porcelain works, and received high testimony regarding the quality. The Imperial Porcelain works, of Trenton, U.S., have pronounced it of a superior quality. The district above-mentioned is five miles from the Montfort Railroad, which connects with the C.P.R.

MOLYBDENITE.

We have enquiries from a party in England about this mineral, which I understand has some new use in a form of alloys, but the price offered (14 cents per lb.), does not give much chance for the opening of our small deposits, which, besides not being developed, are rather far from ordinary communication, we know of only three deposits giving indications of some importance, one on the north shore of the St. Lawrence, and the other in the Gatineau valley. The latter was discovered in Egan township, about 110 miles from Ottawa; the surface indications would justify further development.

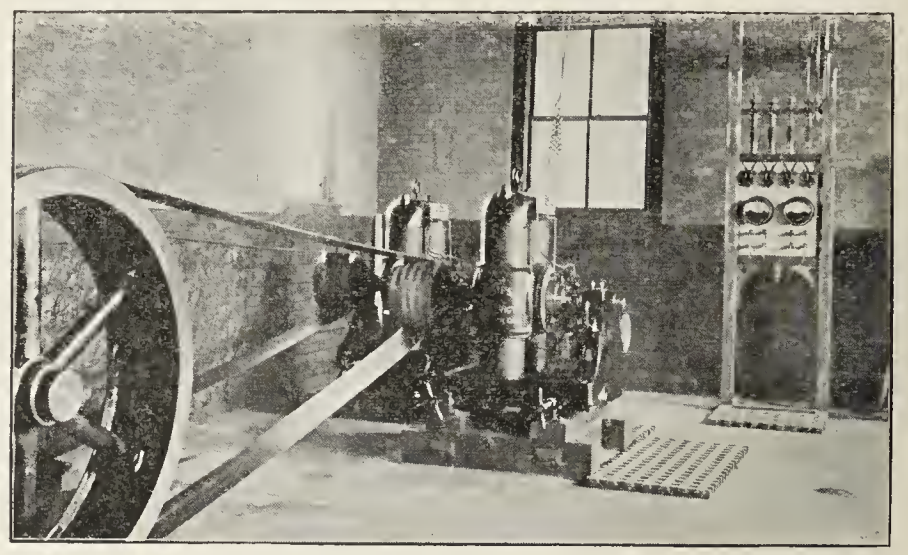
BUILDING MATERIAL.

There is nothing special to mention in this line. We have shipped 3,208 tons of 2,000 lbs. of slate, 90 men being employed, and also 1,072 tons of flag-stones. I am not prepared to give any figure on the building stones, notwithstanding its importance. Re granite, the Stanstead, Whitton and Lake St. John quarries have been in operation, as usual, the latter only for local supply. The limestone quarries, on the Trenton belt, between Quebec and Ottawa, have been extensively worked. We record, for 1897, a production of 14,000 barrels of cement, but new companies are in process of formation, and preparations are made to considerably increase it for the coming year. If we consider the large consumption of such material, in our country, which is partly supplied by an importation of over 200,000 barrels, we may look for a good future for this industry. The established lime kilns and brick-yards are going on as usual. It is not easy to give exact figures regarding the same, as they are scattered all through the province, but by careful researches, I am able to give the following: Approximately, we have, in round numbers, 300 lime kilns, producing one million of bushels of lime, of a value of $140,000, with 250 men employed all the year round. In round numbers also, we count 150 brick-yards, employing 1,200 men for the summer season, and producing 120 millions of bricks, of a value of $600,000.

As a conclusion, I may say that the raw value at the mine of the minerals taken out from this province, represents about $1,800,000, including the building material, the number of men employed the most part of the year being about 4,000.

## CHATHAM MUNICIPAL PLANT.

The electrical equipment of the municipal arc lighting plant installed by the city of Chatham, Ont., last fall, consists of two automatic arc dynamos of nominally 50 lamps capacity each. These are supplying current to 104 arc lamps and 10 series incandescents, through circuits which aggregate some 24 miles in length. The 10 incandescent lamps and two arc lamps are used for illuminating the power-house and adjoining waterworks plant, while 102 lamps are for street illumination exclusively. These latter are provided with substantial telescoping storm protectors, and are suspended from a suitable steel mast arm. Sleet-proof lamp supporting pulleys and thoroughly insulated lamp hangers are used throughout. The outside circuit is of No. 6 B. & S. hard drawn copper wire, triple braided, strung over double petticoat insulators, and at intervals of two



POWER HOUSE—CHATHAM MUNICIPAL PLANT.

miles is protected by an effective magnetic blow-out lightning arrester. Wherever possible, the circuit is divided into loops, comprising some five to ten lamps, each loop being controlled from a substantial absolute cut-off switch.

The interior wiring is of No. 6 B. & S. rubber-covered wire. A plug switch-board, arranged so that machines and circuits may be interconnected, is provided. This is furnished with ammeters and magnetic blow-out lightning arresters of a new pattern, the whole being neatly arranged on a white marble base. The whole plant was subjected to the most vigorous tests which would ever meet the demands of service. The machines were short circuited at full load for one minute, and also while at full load the circuits were suddenly opened. These tests thoroughly demonstrated their ability to withstand any exigencies of service. This was manufactured and installed by the Thompson Electric Company, then of Hamilton, but now amalgamated with the Toronto Electric Motor Co., and doing business in Toronto.

## REPAIRS IN DOCK.

*Editor* THE CANADIAN ENGINEER.

SIR,—I recently ran across what I considered a rather smart piece of work. I was down at the wharf of the American Line in New York city, and noticed lying on the wharf a propeller blade, the tip of which had about two feet knocked off. I made inquiry, and discovered that it had been taken from the starboard propeller of the steamer "New York," which vessel was then alongside the wharf, being in the course of preparation for sea. It transpired that the job of removing this blade commenced just about 24 hours previous to the time at which I saw the men removing the gear and tackle used in dry-docking the propeller, as she was in wet dock. The work was commenced one morning at 10 a.m., the nuts slacked back, of which there were eight, perhaps 3½-inch diameter, the old blade removed, new one substituted, inside the period of about 24 hours. One can readily see what a saving is effected by being able to so make it possible to work in this way at a damaged propeller, and at the same time allow the cargo to be worked. I judge the weight of the propeller blade to have been about four tons. I have spent a night even in a dry dock slacking back nuts on jobs of this kind, and I consider this piece of work on the "New York" quite an example of ingenuity.

Yours sincerely,

JAMES J. SALMOND,
Box 388, Port Richmond, N. Y.

## THE VENTILATION OF PLUMBING APPLIANCES.

We have received a letter from a writer signing himself "Plumber," in which he requests us to ask our sanitary correspondent to give our readers his views on the advantages and disadvantages of the present method of ventilating plumbing appliances and waste pipes, traps, etc. We have submitted the letter to our regular correspondent, W. M. Watson, Toronto, and have received the following reply, to illustrate which the accompanying drawings have been made:

In answering this query, let me first say that if "Plumber" had studied the articles on sanitary matters published in almost every issue of this paper for the past one and one-half years, he would have been already pretty well informed, especially by studying the one in the issue of April, 1897. The first and most important rule in fixing sewer and house waste pipes, is to

arrange every part, if possible, equally graded, with a constant rise upwards, so that a continuous supply of air will regularly pass through every portion except the traps, avoiding any air pockets, where air may lodge motionless and putrefy. See illustration I. in page 351 of the April, 1897, number of THE CANADIAN ENGINEER, except the sink pipes, which by mistake were shown wrong. The method of fixing vent pipes at the highest point of the bend, or knee, of traps, is wrong (see Fig. 1) and in a short time frustrates the intention in so placing it,

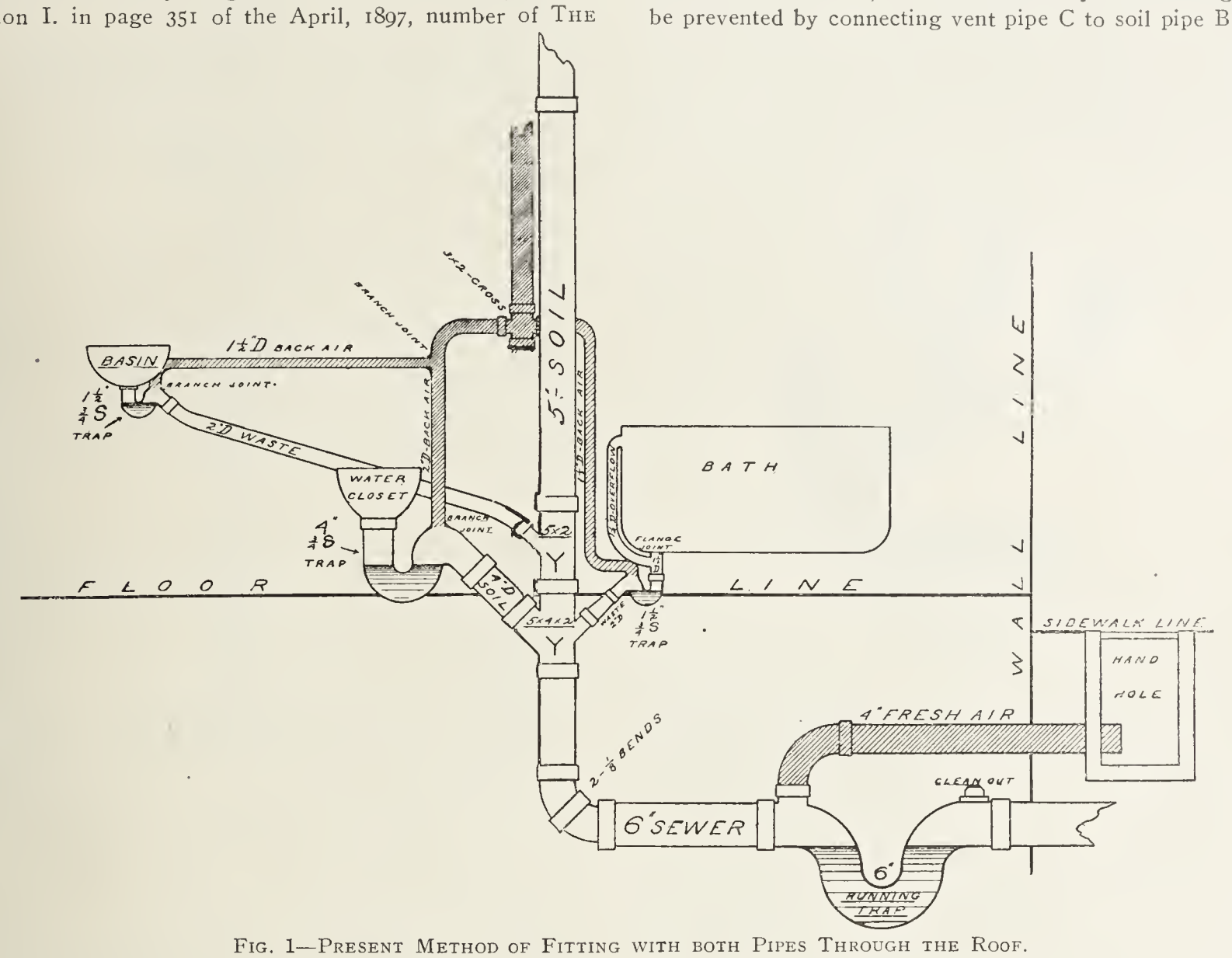



FIG. 1—PRESENT METHOD OF FITTING WITH BOTH PIPES THROUGH THE ROOF.

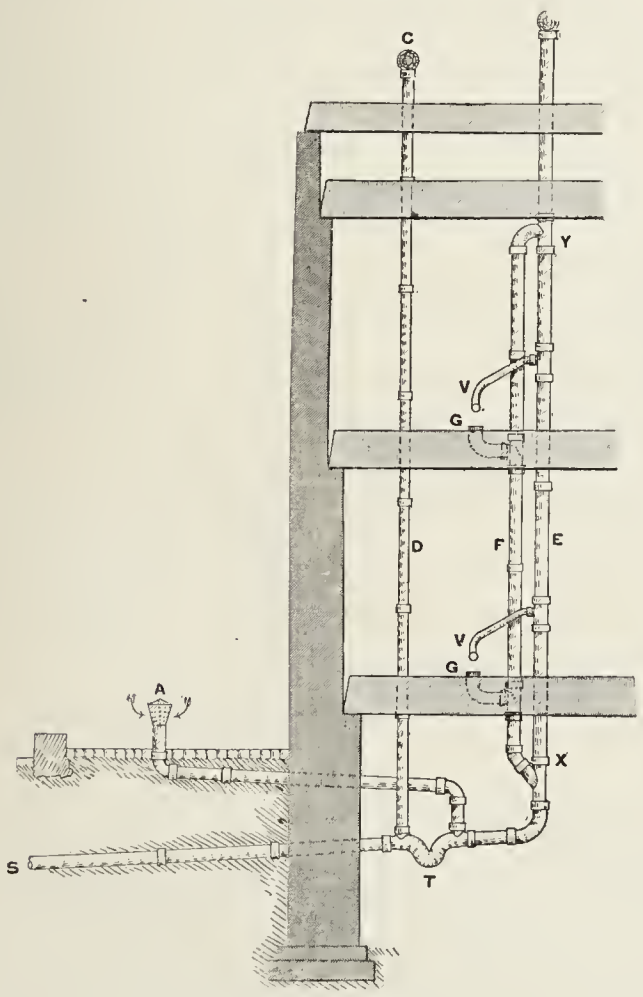
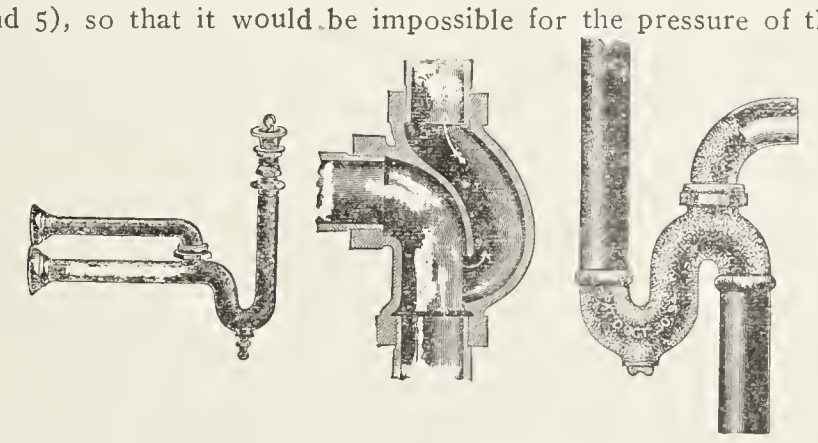



FIG. 2—SEWER VENT.

because each time that soapy water is forced round the sharp bends in the trap a froth is formed which flies up into the vent pipes and dries on like a coat of paint; gradually closing the opening until the pipe becomes useless. Moreover, wherever there is a separate stack for the use of ventilation alone (see Fig. 1), there is often a strong down-draught, varying momentarily, according to the pressure changes of the atmosphere at the terminating points, which causes an oscillation of the water seal in the most sensitive traps fixed on the line. That causes the seal to overflow, and break the key. This might partly be prevented by connecting vent pipe C to soil pipe B, at junction, Fig. 2. Therefore, it is always safer to join the main ventilation pipe into the side of the soil pipe stack (see junction Y, Fig. 2), at a point before it passes outside, when in that case the down-draughts will act directly and squarely down the soil pipe to the main drain, or through the floor line breather pipe. The illustration in the April number will also explain this point still more. Then, vent pipes that are open to the outside air convey a drying atmosphere to the water seal, which quickly absorbs the moisture, drying out a 1½-inch trap very quickly, especially if the pipe is attached to a separate ventilation stack, or the vent is coupled in a way that the body of air presses squarely on the water seal contained in the trap (see Fig. 6 and Fig. 1), or there is hard, dry frost, or hot, drying air outside. They also often act as an overflow tank when the waste pipe is choked, because of the sewage forcing upwards into them when it can not freely flow downward by the proper pipe, gradually dribbling away down the waste pipe afterwards. They form obstructions, and often cause stoppages by small points of solder dropping in when wiping the joints, and also the roughness of the end of the vent pipe, peeping through at an intricate point where smoothness of turn is absolutely necessary. Therefore, if vent pipes are needed, they ought to be inserted a few inches backward from the crown of the bend (see Figs. 3, 4, and 5), so that it would be impossible for the pressure of the



FIGS. 4, 3 AND 6.

atmosphere to rest directly on the off-side of the water seal of any trap.

Plumbers may have noticed that the vents of English-made w.c.'s are never on the crown point, but act almost as a right

angle branch. They make it hard to remove a choke in a waste pipe that is vented, because a force pump is useless, the fluid passing up the vent when it ought to be making pressure in the waste pipe to force the obstruction.

The fad of the so-called trap syphoning is almost a canard. It can easily be done, but it does not occur naturally once in 100,000 times. There is a danger of the traps being drawn in places where soil pipes stop at the closets, and there is no vent of any kind through the roof, and the w.c. used is of the George Jinnings or Demarest kind, that drops about three gallons of

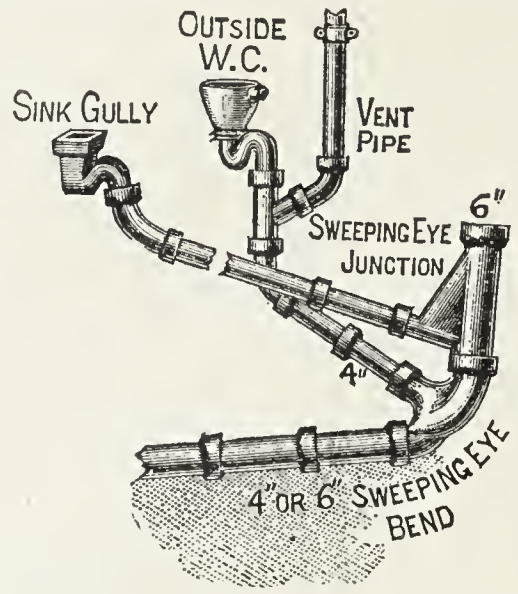



FIG. 5.

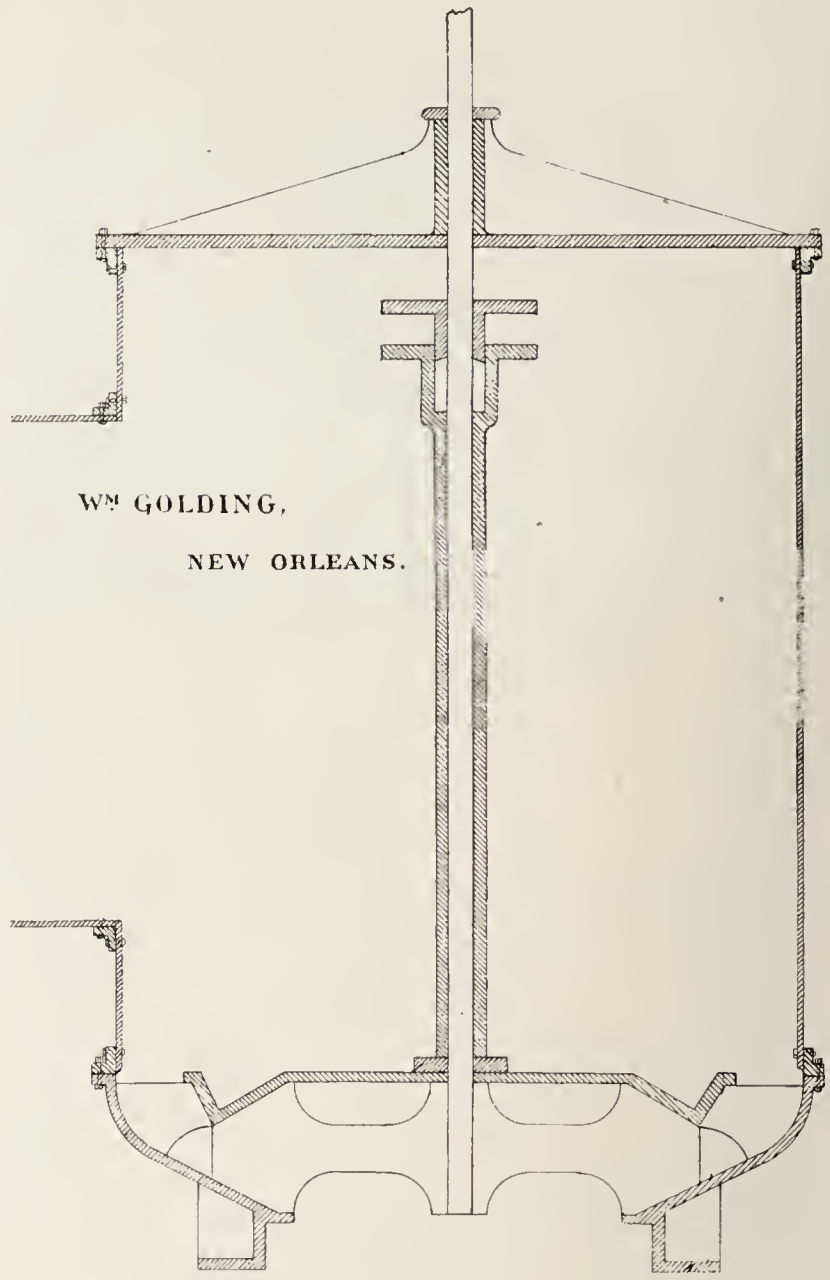
water and the excrements, etc., down the soil pipe suddenly, like a piston passing down a smooth cylinder, causing a considerable vacuum behind, because there is no vent pipe to bring in the atmosphere and fill the space, so it must needs draw it through the w.c. trap, and should it not have reached a larger pipe or sewer before the valve is dropped down again (of course backing the air from going that way), then the vacuum will draw any or all of the small traps in the house. But a water closet flushed by cistern and 1½-in. lead pipes can never syphon any traps, because the water and solids do not go down in bulk sufficiently large to fill a space of a 4-inch pipe, and the air will pass off in the opposite direction. Nor can syphoning ever occur where the soil pipe end is open above (see G. Fig. 2), and also sketch in last April number. The intricate fittings and methods of arranging pipes have caused more premature deaths than the well-appointed and carefully-constructed plumbing put in over thirty years ago, which was totally void of ventilation, but which also never had any dried-out water seals, which in Toronto are answerable for many deaths.

Three years since, I was privately engaged to go to a house having the best and latest designs and workmanship in plumbing throughout the place. I arrived in time to see some members of the family taken away by diphtheria, leaving only the nurse and another ill in the house. I proved enough to believe that it was the overdone plumbing and dried-out trap seals that hurt them, and if the eyes of those who understand air currents and sanitary matters were properly used, more such proofs of the danger of going to extremes in sanitary matters would be forthcoming.

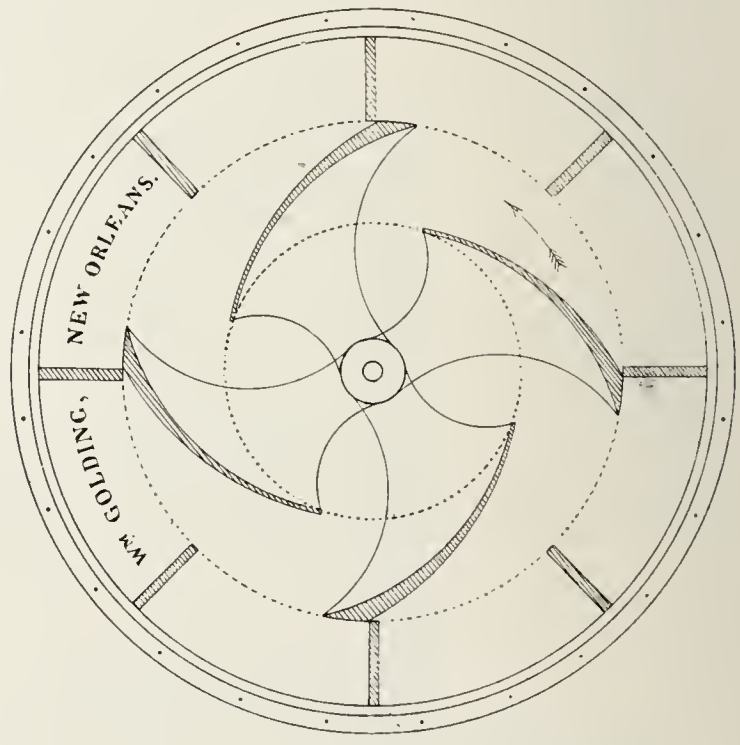
I have so far dealt with the evils of the present method of connecting ventilation pipes to waste pipes, and fixing them often where they are not needed, and where they do a real and positive harm, but the law requires them so to be placed, and though it was made probably by men void of practical knowledge and very ignorantly stupid in such matters, it must be carried out, if the whole town is injured thereby. In another article I will try to show the advantages the present method possesses.

## CENTRIFUGAL PUMP.

The annexed sketches illustrate a type of centrifugal pump, the invention and design of Wm. Golding, C.E., New Orleans, La. The feature of this pump is the wheel cover, which rests in taper fit upon chucks, that are cast on the lower portion of the wheel box. There is no fastening to this cover, none being required, as the weight of the water will hold it down. Should the wheel break, or should any obstruction prevent its free movement, the cover and wheel may be removed from the case by simply taking away the upper spider. The lower part of




the discharge branch should be placed on a level with the minimum height of outfall receptacle, while the upper portion of discharge branch will be on a level with maximum height of outfall receptacle. The driving power will be attached to end of the wheel shaft above the spider. To ascertain the discharge




capacity of this pump, ascertain the cubic contents of wheel box (between dotted lines), and multiply by 4, for 4-bladed wheel, and by 5 for 5-bladed wheel, etc., etc., for each revolution of shaft, for the reason, as will be seen, that the wheel box is emptied four times per revolution. To ascertain the power required, ascertain the foot pounds in the quantity to be lifted, and add 50 per cent. The efficiency of this pump when properly installed is claimed to be 85 per cent of the power applied to the shaft.

**MOVING TIME!! Subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses.**

**THE PUBLISHERS.**

## EXTRACTS FROM ADDRESS OF GEO. E. DRUMMOND, PRESIDENT FEDERATED CANADIAN MINING TRUST.

Within the next few months Great Britain will pour into this, the first of her colonies, thousands of her sons and a vast amount of capital. The United States and other countries will contribute their quota in men and money, and Canada stands upon the threshold of a great national advance that means not only an early increase in material wealth, but what is equally important, that her natural resources shall at least be better understood and better valued both at home and abroad.

We who are directly interested in mining know that the Klondyke represents but a very small part of the great natural wealth of this country, and we are, therefore, confident that, properly directed, the workers and capitalists now coming to our shores, if by chance unsuccessful on their first adventures on the gold mines of Canada, can be absorbed to their own benefit and to that of the Dominion in many other fields of lucrative labor and investment which this country affords. The wealth of our coal fields and iron mines is undoubted. We are rich in silver, copper, asbestos, mica, plumbago, phosphate, chromic iron, galena, corundum, talc, and almost every mineral known to science.

Without presuming to dictate to our English and European friends, the members of this association may be permitted to express the opinion that the Canadian mining engineer, acquainted with this particular field of operation, experienced in the ores of this country, and fully understanding the climatic conditions under which the work has to be carried on, is better fitted to cope with and overcome natural difficulties than, for instance, an engineer who may have gained his experience on the free milling reefs of South Africa.

The official returns of the Geological Survey of Canada, just published, calculates the total production of minerals in Canada during the year 1897 at $28,789,173, an increase of $617,934 over the production of 1896. In 1886 the total production of minerals in Canada only reached a value of $10,000,000. What can better attest the importance of developing the mining industries of the Dominion than this advance of nearly 188 per cent in the short space of eleven years. . . .

In reviewing the different sections of mining, the address continued: The coal areas of the Dominion are estimated at 97,200 sq. miles, not including areas known, but as yet undeveloped in the far north. First the coal fields of Nova Scotia and New Brunswick; second, those of Manitoba and the North-West Teritories, and third, those of British Columbia.

The operations for 1897, so far as reported by the Bureau of Mines and the various companies interested show as follows:—

| | |
|---|---|
| In Nova Scotia, coal raised | 2,345,138 tons. |
| " New Brunswick, coal raised | 6,000 " |
| " Manitoba and North-West Territories, coal raised | 297,000 " |
| " British Columbia, Vancouver Island collieries, coal raised | 798,458 " |
| | 3,446,596 tons. |

The production of coal for 1897 may be put down at a value of at least $7,000,000.

*Coke*—Nova Scotia reports the production in 1897 of 58,000 tons of coke.

We are without actual figures for the production in other sections, but it is gratifying to note that the coal companies of the Dominion are gradually extending their trade, export as well as native, through the medium of their coking plants.

Quoting from the Canadian Mining Manual of 1897: In 1884, 49 steamers, 18 sailing vessels, and two large barges were employed in the St. Lawrence-Maritime trade, when $360,680 were distributed for labor in transportation, trimming cargo, handling, etc., and $55,556 for wharfage, and $55,333 for pilotage. In all a total for these three items of $480,577.

*Iron*—During the earlier months of the year the Nova Scotian furnaces, as well as the one situated at Hamilton, Ont., were practically closed down, awaiting the decision of the Government regarding the tariff. That happily settled, the furnaces went to work (the Hamilton furnace as late as 29th June), with the result that at the close of the year the returns show an output of coke iron pretty well up to that of 1896 and an increased output of charcoal iron. Advices received from New Glasgow, N.S.; Londonderry, N.S.; Radnor Forges, Que., and Hamilton, Ont., report a combined gross production of about 57,904 net tons of pig iron, 18,562 net tons of steel, 1,403 net tons of forgings, 4,646 net tons of bar iron, puddled bar and other finished products, the three last mentioned items reported by the Londonderry Iron Co.

The capital invested, the number of men employed and the quantity of materials used remain practically about the same as in 1896. The output of charcoal iron at the Radnor Forges furnace, included in the above returns, shows an increase of 50 per cent. over the operations of 1896. The whole outlook in the Canadian blast furnace business is promising.

Our charcoal iron has taken front rank in point of quality, and so far as coke iron is concerned, Canadian founders now acknowledge the product for home furnaces to be equal in every way to the imported American article.

*Ferro-Manganese*—During the year the plant of the Pictou Charcoal Iron Company at Bridgeville, N.S., has been leased to the Mineral Products Company, who are undertaking the manufacture of ferro-manganese. The company has secured important concessions in manganese mines in Albert county, N.B. These operations will be watched with considerable interest by members of this Institute, who wish the new venture every success.

*Chromic Iron*—The returns for 1897 are not yet completed, but we are glad to be able to report shipments by the Quebec Central Railway to the extent of 2,593 tons. The quantity shipped in 1896 from the mines of the Province of Quebec, with points of destination, was as follows:

| | |
|---|---|
| To Philadelphia | 750 tons. |
| " Pittsburg | 1,232 " |
| " Other points | 55½ " |

Mr. J. Obalski, Inspector of Mines, Que., estimated in his report for 1896 that during the preceding four years 10,500 tons of chromic iron had been raised, of which quantity 9,000 tons was shipped from the Province of Quebec. A concentrating plant is badly wanted to raise the values of a very large quantity of this mineral in the Eastern Townships, at present too low to market at a profit.

*Mica*—Quebec Province reports the total production to a valuation of $125,000, and we are also glad to report English capital recently invested in Ottawa County mines.

*Phosphate*—Some phosphate has been taken out during the past year in working for mica, and enquiries for this mineral are more numerous, although the prices offered are as yet too low to admit of actual business.

*Gold.*—Of all our mineral wealth, gold has excited far the greatest interest. . . . . The total production in Canada in 1897 is reported by the Geological Survey of Canada as $6,190,000.

The President then reviewed the conditions in the Yukon, British Columbia, Nova Scotia, Quebec, Ontario, and concluded: A matter of note is that important indications of gold-bearing quartz are found in the Sudbury district at Lakes Wahnapitae and Temogaming. This district, already famed for its deposits of nickel ore, is said to be very promising in gold.

*Silver.*—The total output for 1897 was 5,558,446 ozs., valued at $3,322 905.

These minerals continue to be the principal source of dividends in British Columbia, substantial profits having been realized by the Slocan Companies, among others the Payne, Whitewater, Peco, and the Hall Mines, Ltd. The figures for the past year are not yet reported, but they show an increase upon those of 1896.

In Ontario, a number of mines in the neighborhood of Port Arthur have been re-opened.

In Quebec important operations were begun, and shipments made from Calumet Island, Ottawa County. A valuable deposit of argentiferous galena has also been discovered in Brome County, on the shores of Lake Memphremagog, which is now being investigated.

*Lead.*—The total production in 1897 amounted to 39,018,219 ozs., a value of $1,396.853.

*Asbestos.*—The Geological Survey report gives the output of asbestos and asbestic as 25,262 tons, valued at $324,700. The shipments reported by the Quebec Central Railway for 1897 show:

| | |
|---|---|
| Black Lake | 1,020,425 lbs. |
| Thetford Mines | 16,110,135 " |
| | 17,130,560 " |

It is pleasing to note the considerable trade that has sprung up for the refuse sand and short fibered asbestos for use as fireproof plaster, for which purpose it is admirably suited.

*Copper*—The copper ore mined in the Province of Quebec during 1897—39,928 net tons. Of this quantity 31,080 net tons went to the United States, the remaining 8,848 tons being treated in Canada. These figures show an increase over those of 1896 of 7,448 tons exported to the United States, and a decrease of ore treated at home of some 1,344 tons. The market in the United States has been in a healthy condition, with an active demand and well-sustained prices throughout the year.

In Canada the reduction of the import duty on sulphuric acid has resulted, as feared, in opening our market to the American manufac-

turer, in consequence of which there is a decrease in home production and also lower prices.

The Bureau of Mines of Ontario reports the production of metallic copper to the extent of 2,750 net tons, of a value at the works of $200,067.

Shipments of blister copper to Great Britain are reported by the Hall Mines smelter at Nelson, B.C.

*Nickel*—The Geological Survey Report for 1897 places the total production in Canada as 3,997,647 lbs., valued at $1,399,176.

Mr. Archibald Blue, Director of Mines of Ontario, reports:—

| | |
|---|---|
| Nickel ore smelted in 1897 | 96,094 tons. |
| Metallic nickel contents | 1,969 " |
| Value at works | $359,651 |

In certain quarters efforts are being made to induce the Government to impose an export duty upon Canadian nickel.

*Gypsum*.—The total production for Canada reached 239 691 tons. The output for Nova Scotia and New Brunswick combined reached 150,000 tons.

The other industries such as oil, natural gas, salt, graphite and building materials, show no specially new features, and returns of same are not yet to hand.

## COMMERCIAL PROGRESS AS INFLUENCED BY THE DEVELOPMENT OF THE IRON INDUSTRY.*

Commercial prosperity is proportionate to the capacity of a country to produce what is required by its citizens, to its financial ability to sustain these products, and to the facilities for distributing what it is able to supply. Disclaiming any desire to minimize the important bearing upon national advancement which should be credited to the other specialties, the iron industry may be given the leading position. Few articles which we manufacture have been so liberally discussed by political economists as pig iron, and in legislation concerning customs' duties, this product has assumed such a prominent position that we may infer that this particular industry is recognized as exerting a marked influence upon the country and especially certain sections thereof. Facts sustain the inference that probably no one industrial pursuit, except possibly coal mining, has done more to advance the United States than the production of pig iron, and by this product and its subsequent manufacture much assistance has been given to the development of the coal mining industry which now contributes about 71,000,000 tons annually or 30 per cent. of the world's coal output. Having a general knowledge of what has been done towards the establishment of a Canadian iron industry and the efforts to encourage this by Government assistance, some application of the foregoing conclusions to the future of the Dominion may be expected at this time. The suggestions offered are not based upon detailed knowledge of local conditions, for I realize how much better equipped others are to discuss this subject locally. But it may be possible for one whose personal work has included numerous investigations of the adaptability of various locations for the establishment of iron and steel works, and whose examinations have embraced some of the deposits of the Dominion, to present new phases of pig iron production as exemplified in the records of progress of the United States, which may be applied to Canadian development. Canada is well supplied with iron ores, many of them of excellent quality; some have withstood any cost of transportation and paid duty for consumption in the blast furnaces of the United States, several hundred miles from where they were mined. The problem which seems to retard the Canadian industry is the bringing together of satisfactory fuels for smelting and ores of desirable character close to points of distribution or consumption. In determining the advisability of a district or individual location for the production or manufacture of iron or steel, the requirements are: (*a*) The facilities of obtaining raw material of satisfactory character, viz., iron ores, fuel and flux, their cost, and the character of metal which they will produce advantageously; (*b*) the market which can be conveniently reached, or which can be developed, and the character of product most in demand; (*c*) the transportation facilities, both existing and prospective, and rates obtainable on raw material and finished products; (*d*) the supply and cost of labor, and the conditions which may cheapen or enhance the wage rate; (*e*) the relation which the local bears to other established concerns which may make similar products, and the competition which must be met from these; (*f*) the character of works which can be constructed, and cost; (*g*) the cost to produce pig iron, and to manufacture iron and steel of the forms most in demand; (*h*) the probability of other locations where no iron is made, but possessing equal, or in some cases superior, advantages, engaging in iron production; (*i*) In countries like the United States and Canada the trend of increasing population demands consideration. The problem is, therefore, by no means a simple one, and in the light of recent concentration of numerous plants under one general management or control this question of ample capital to build up, equip and operate works adds another factor.

*Extracted from a paper read by Jno. Birkinbine, Philadelphia, before the Federated Canadian Institute, Montreal.

In 1897 almost 12,500,000 tons of ore were shipped from Lake Superior mines to furnaces, some of which are 1,500 miles distant, the average distance between mines and furnaces using the ore being probably 800 miles. These ores have gone partly to meet the fuel, but the predominating attraction has been the market afforded for distribution of the metal produced and the articles manufactured from it. A brief summary of the development of the iron industry of the United States may be given in a statement of the rapidly increasing output of pig iron, this being the basis of the entire industry:

| Year. | Gross tons of pig iron made. |
|---|---|
| 1810 | 93,908 |
| 1830 | 165,000 |
| 1840 | 286,903 |
| 1850 | 563,755 |
| 1860 | 821,223 |
| 1864 | 1,014,282 |
| 1870 | 1,665,179 |
| 1872 | 2,548,713 |
| 1880 | 3,835,191 |
| 1881 | 4,144,254 |
| 1886 | 5,683,329 |
| 1887 | 6,417,148 |
| 1889 | 7,603,642 |
| 1890 | 9,203,703 |
| 1897 | 9,652,680 |

In the past three months the production has been at the rate of 12,000,000 tons per year. Taking the census reports for the half century, the data indicates that the pig iron output of 1890 was over 32 times that of 1840. Improved machinery and technical knowledge applied to iron smelting has done more than anything else to secure the advancement indicated. While pig iron is a most important factor in the development of a district, province or nation, its manufacture cannot be made successful without the use of good business management and technical knowledge. Even with this, failure may follow the location of plants without giving the matter thorough investigation.

Mr. Harvey Graham, who was called upon by the president, agreed with the remarks of Mr. Birkinbine, and drew attention to the immense amount of coal required to make 1,000,000 tons of pig iron per month —say, 2,000,000 tons of coal.

## THE CHEMISTRY OF FOUNDRY PRACTICE.

BY ERNST A. SJOSTEDT.

(*Concluded from last issue*).

The powerful influence of sulphur in changing the character and fracture of the pig iron has more than once been forcibly brought to the personal experience of the writer, and an extreme case was met with several years ago at Kathadin Iron Works, Maine, with iron made from a bog ore that contained from 1 to 3 per cent. of sulphur, and which at the time was only imperfectly roasted. Analyses of several samples of all grades of this pig iron—from open gray to white and spongy—revealed the presence of sufficient silicon, which under ordinary circumstances would have made them all gray and soft, but the varying amounts of high sulphur present was here the determining agent, as we see from the following table:

| No. | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silicon .. | 3 09 | 3.10 | 2.35 | 3.55 | 2.00 | 2.74 | 2.70 | 2.22 | 1.30 | 3 89 | 3.05 | 2 73 | 1.00 |
| Sulphur... | .03 | .13 | .18 | .39 | .19 | .20 | .34 | .12 | .18 | .60 | .46 | .65 | .43 |

Here, thus, we have a white iron with nearly 4 per cent. silicon, which but for the .6 per cent. sulphur present would have shown an open soft gray fracture.

An element we often hear about, and which when present even in the smallest quantity in steel is much dreaded, is *Phosphorous*. In foundry pig, however, a certain small amount is not only permissible, but highly desirable, as it lowers the melting point of the iron and makes it fluid, thus causing it to retain its heat longer and making it suitable for producing small castings of a delicate pattern. Pig iron with less than .2 per cent. P is apt to shrink. But when it is present to over .75 per cent. the iron becomes brittle—this in proportion to an increased percentage of carbon present—and strong castings should not contain over .5 per cent. phosphorous. It unites readily with iron to about 26 per cent., but the pig iron in the market contains from a trace to 1.5 per cent. Phosphorus is not eliminated in the cupola smelting, and its presence should therefore be kept run of.

*Manganese* is also an element to be taken in consideration in foundry practice, for so many iron ores contain this metal, and a certain

amount enters the iron during the blast furnace process, while part combines with the lime and the sulphur, and is removed with the slag. Its most striking property is to make the iron "chill," *i.e.*, prevents formation of graphitic carbon. But this chill does not make a durable wearing surface, as it is more crystalline than hard, and readily crumbles under the impact of rapid shocks (to which, *e.g.*, a car wheel is subjected). Its presence up to one per cent., however, is not considered detrimental, but a high percentage of manganese makes the casting brittle and white—provided the silicon is not exceptionally high, in which case (as in some Scotch foundry pig of good repute, which carry two to three per cent. of manganese), the graphite is separated, and a gray iron obtained. Iron alloys with manganese in all proportions, and when the amount of manganese runs between 20 and 30 per cent. the product is called ferro-manganese, and when containing from 5 to 20 per cent. it is termed "spiegel" iron. Manganese raises the point of saturation for carbon, *i.e.*, permits of a high total carbon. So while iron without any manganese rarely contains over 4.5 per cent. carbon, ferro-manganese often runs from 5 to 7 per cent. (nearly all of which is in the combined state). Owing to its affinity to sulphur, it acts as a "purifier" (even more so than lime), in the cupola, removing oxides of iron and silicon from the molten iron, and thus helps to prevent blow holes.

A metal which during the last decade has come in great favor as an admixture to iron and steel is *Aluminum*. [The credit of first calling attention to the influence of aluminum on iron castings belongs to a Swedish inventor who introduced the so called "Mitis" castings, a mixture of wrought iron and aluminum]. The principal effect this metal has upon cast iron is that it lowers the melting point of the alloy, consequently increases its fluidity and makes it run quick and sharp, besides giving the gases an opportunity of escaping from the molten iron, hence its reputed property of preventing blow holes. Like silicon, aluminum tends to make a gray iron, and lessens the tendency to chill (*i.e.* favors the formation of graphite), and if allowed to take the place of silicon it will make a stronger and softer casting than if silicon were the agent; but added to an iron already high in silicon it makes it weaker. An addition of aluminum, therefore, is beneficial only to a low silicon pig. If added in sufficient quantities (2 per cent. and more) aluminum, for the same reason as silicon, prevents shrinkage.

Other elements, such as titanium, arsenic, copper, nickel, chromium, etc., also exert their influence on the character of the iron, but they rarely occur in sufficient quantities to require looking for.

From what already has been said, it follows that carbon is a necessary, but passive component in the pig iron, made to change in amount and in form by the presence of other elements. Thus sulphur and aluminum tend to change the carbon into graphite, while sulphur, manganese and phosphorous do not cause carbon to leave its combined state. Sulphur, manganese and combined carbon increase the tendency to shrinkage, while silicon and phosphorous help to counteract this evil, and the more of the effective element the iron contains the more is its action facilitated or retarded, as the case may be.

According to the state in which the carbon is present in the pig iron its grading is determined; but as we have also seen how largely the proportional amounts of graphite and combined carbon are dependent on the many foreign elements present, and to a great extent also on the conditions under which the metal has been allowed to cool, it will at once be evident how uncertain and unsatisfactory it must be to try to judge the quality of the iron simply from the fracture it presents. On the other hand, it is not claimed that the physical properties of an iron are wholly dependent on a certain chemical composition, for there are several possible and proper compositions for an iron intended for any certain purpose, "each of which depends for its physical success on the manner of working the iron, as the full blast, temperature, etc., and on the relative proportions of one element to another, as well as on the actual amount ot each present." But before we institute chemical investigations we do not gain a true knowledge of what *causes* these different physical qualities in the iron, nor is it otherwise possible to ascertain the true composition of the pig iron or the cupola charge. In trying to remedy any evil, the first step to be taken, after all, is in the direction of discovering the *cause*, after which a restorative generally can be found. And, as said at the Foundrymen's Association in Philadelphia some time since, "in forming his deductions the chemist's mode of procedure is singularly simple, reasonable and practical. As a result of years of scientific experience, theory and actual practice, it is known that certain impurities in the material produce certain characteristic effects on its physical behavior; and these impurities may be eliminated, retained, or forced into combinations with others, according to fixed laws and conditions to which they are subject. There are founders who can get along without chemical services, but there are very few who could not obtain practical benefit from a use of the knowledge now obtainable upon this subject."

Montreal, February 10th, 1898.

## THE STEAM ENGINE.

*Editor* CANADIAN ENGINEER:

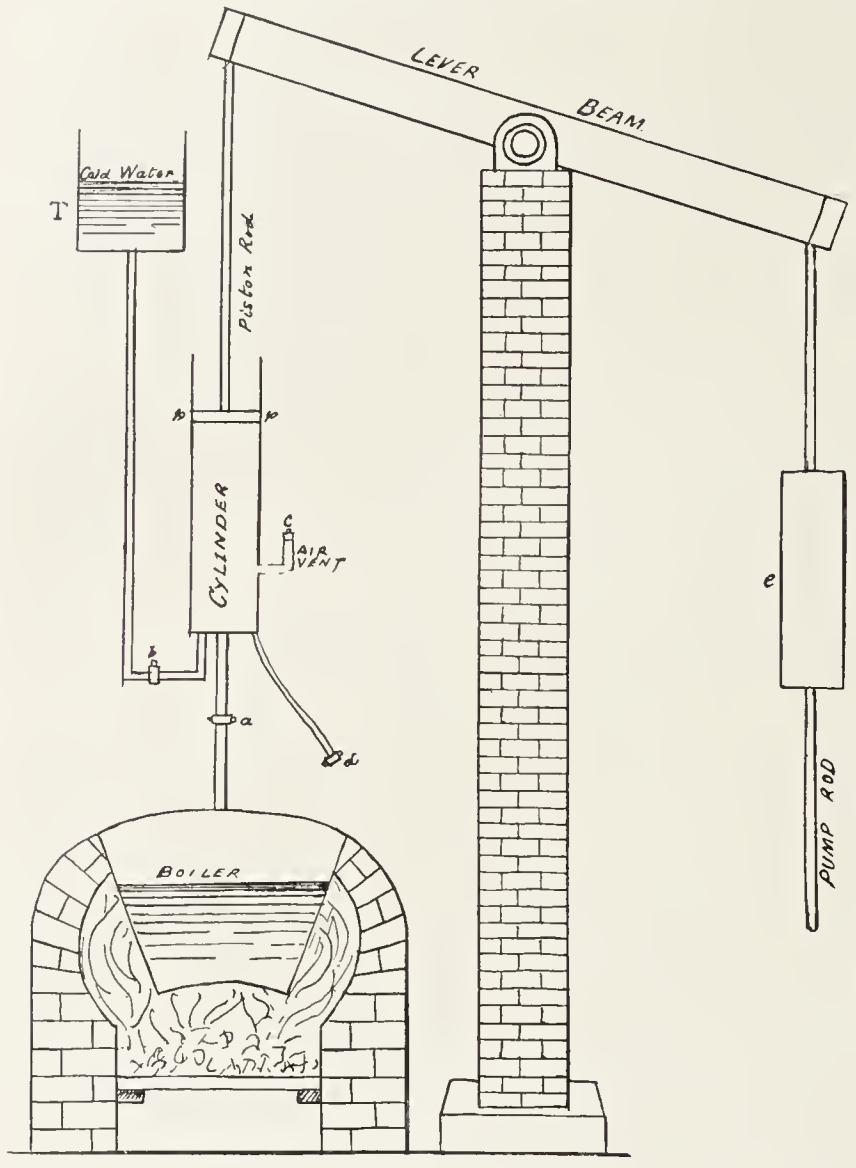
My last letter to you was on the setting of boilers. In this paper I propose to speak to the young engineers and readers of your valuable journal, THE CANADIAN ENGINEER, and address them as my sons. I will now draw your attention to the horse-power, or the power of a horse, and the duty which may be expected from a horse day after day; the power and duty of a steam engine or any and every machine has been and is now measured and compared with the power and duty of a horse as a unit.

Sixty years ago I was fifteen years of age and had served the first year of my seven years' apprenticeship in the boiler shop of one of the largest foundries in the west of England. My second year was designed to be spent in the erecting shop, so I had to spend much of my time among the mines taking down old and putting up new engines and machinery. My curiosity was aroused in looking through the storerooms of the mines. I saw many old tools and parts of machines. I made enquiry about their use. There in a corner lay an old leather bag or bucket, likely it had not been moved for many years. Being inquisitive, I asked the old storekeeper its use, and how long it had been there? He said, "many years ago, when I was a young man, about the close of the last century, 1790, instead of having an engine to pump the water from this mine, as you are now taking out, and the large new one you are about to put in, we had to draw it out with this leather bucket. A rope over a large pulley drawn by a horse, a heavy framework of timbers stood over this shaft with a large pulley on the top, and over that road the horse used to travel drawing the rope over it. A slow motion, but it had to be kept going. When one horse's eight hours were up another took its place, which would not keep the mine clear of water, being much deeper now and more men employed in bringing up the copper." Now a good reason was given for using leather bags. It would not knock down anything which happened to be loose on the side of the shaft, for the miners went up and down the same shaft. If the ore was brought up the same shaft it was made large enough to bare in a part for the iron bucket or cibble to pass up and down. Another pulley was provided and placed in the framework over the shaft for a chain to pass over in a groove.

The miners did not then go up and down in elevators as now, but had ladders placed perpendicularly fastened to the side of the shaft with iron rungs, and about every 100 feet a resting floor was made for them. I well recollect, after coming up six hundred feet over such a ladder, I was tired enough. The miners wore hard felt hats with wide brims to protect their heads and shoulders, with a piece of clay stuck on the brim and with a candle in it to give them light. There were no matches and Davey lamps as there have been since; it was a very unfortunate thing for them to lose their light. I one time went into a place like a large room; there was not sufficient air to feed it. My light was gone, all was dark; I had to grope my way to the nearest wise man, whose light still burned (you young men be sure you do not get into such a position with your excited mining speculations). It is very nice to hear the voices of the miners coming up the shaft, singing some well-known tune in their lively meeting houses and keeping time with their feet on the thaves of the ladders as they go up and down, and sometimes at their work, to go through a well regulated mine and ramble through long tunnels, observe the way they work to get out the ore; sometimes it is not all pleasure nor profit to the worker, nor investor—but I have wandered off, I must return to my text.

The horse power, and his duty drawing up water for eight hours per day, was an important subject in the year 1698. Some 300 years ago Captain Savery obtained a patent for a steam engine, to draw up or force up with a pump the water from the mine instead of the horse arrangement, he called it the miners' friend, and after he had it going he found his engine would force up as much water as twelve horses in a day, then he called it so many horse-power. Their cost also had to be compared, to calculate the advantage of using steam (that great natural force they had learned to bridle and harness); it soon became noised through the mines and country that the horse had been superseded by the steam engine, for it could run night and day for less cost than the three horses. The excitement caused a number of the thinking men to turn their attention to making steam turn the mills, factories and other machinery. Companies were formed and a great deal of money spent. Newcomen, Cowley and Savery formed one company in England, others in Scotland built foundries. Steam was the great topic of the day. This Newcomen Company got seven teams of horses in a field, in a ploughing match. It was found the average weight a horse could draw through the day was 163 pounds,

and travel 2½ miles per hour. Another trial was made by them some time after with 144 horses drawing a weight with a rope over a pulley eight hours per day, to be on the average 150 pounds, and traveling 2½ miles per hour; but the most direct way for them to get at the




NEWCOMEN ENGINE.

(*a*) Stopcock between boiler and cylinder; (*b*) Stopcock between cold wate tank and cylinder; (*c*) Valve closing air-vent; (*d*) Valve closing the outlet for con dens·d steam; (*e*) Weight which drags down the beam; (*pp*) Piston which is pressed down by the atmosphere when the cylinder is empty.

power of their engine was to find how many gallons of water a horse could draw up in eight hours out of a mine so many feet deep, which they did, and found their engine would force up as many as 100 horses in the time; the horse-power to them then became their unit or standard for making their engines.

In 1705 this Newcomen Company was formed. Newcomen, being a very active man in business, made a model engine for the University of Glasgow of brass about the year 1710; the cylinder was two inches diameter, six inches stroke (this engine had some improvements over Savery's); the boiler was made of copper, nine inches diameter, without a safety valve. At times the steam rose too high, 75 to 100 lbs. per square inch, but had to be governed by the regulation of the fire. The cylinder of this engine stood directly over the boiler, and was connected by the steam-pipe. This cylinder had a bottom, but no cover for the top, so that the piston could be seen and the air-press on the top of it. This pressure of about 114½ lbs. per square inch is the power of the engine. The cylinder being 2 inches by 2 inches by 7,854 = to 3.1416 square inches on the piston, by 14½ lbs. atmospheric pressure, gives about 45½ lbs. on the piston, so that whatever size engine was required the size of the piston was given and number of pounds expected of it, providing the piston was airtight in the cylinder, and a good vacuum was formed under it by the steam raising the piston up again. The steam was then condensed and the cylinder cooled by a spray of cold water let in, and was let off from the cylinder. A part of this warm water was used to feed the boiler. The tap or valves had to be opened and shut by hand every stroke. One day the boy, Humphrey Potter, wanted to be relieved of his duties; he saw he could tie a lever and a string to the working main beam to do his work. The piston rod was fastened by a chain to a wood beam one end and the other end to the water pump. To such ingenious boys we are greatly indebted for our many improvements we have to-day. This engine remained in the museum of the University for many years. A number of professors and students looked at it and passed by. Sixteen years after it was made, a little boy was born in Greenock; his father rejoiced and said he had a man from the Lord, and called his name James Watt, 1736. Being a mechanical ship-builder, he trained his boy to be mechanical, too, by giving him tools to use when out of school. Being rather weakly, his mother kept him home and taught him good, scientific knowledge and honest principles. At the age of 12 years he was found by his aunt in her kitchen, watching the steam coming out of the spout of the kettle; he stopped it from coming through the spout and put a weight on the cover to see what it would do. The steam rose and blew off the cover, and some of the water into the fire. This caused his aunt to come and see what had happened. She scolded him for wasting his time and the water she wanted and told him to go home to his mother. Her displeasure did not stop his thinking about the much talked of steam among boys and men; of what it was doing in the mines taking the place of the horses. At the age of 16 years, Watt was sent to London to learn the art of a mathematical instrument maker, that was then one who made clocks, fishing tackle, sailors' compasses, quadrants, doctors' tools, university and school instruments, and a variety of things to be repaired. At the age of 21—1757—he left London and went to Glasgow, opened a little repair shop for anything he could get any money by, for he had to depend on his own income, as his friends were much reduced by heavy losses. The professors and students of the university visited his shop for repairs; that same year he was appointed instrument maker, and had rooms provided for him in the University of Glasgow. Among many other tools he had to repair was Newcomen's engine, and to see further what it could be made to do, as for 47 years little had been done with it. He soon discovered its great defects and what was wanted, he found it took six pounds of cold water to condense one pound of steam (one pound of water will make one pound of steam) and cool the cylinder so as to form the vacuum required; the great idea struck him if he could keep the cylinder hot and get clear of the steam, he could put a cover on the top and cause the piston to descend by the steam with much greater pressure than by the air 14½ lbs. His mind seemed to be fully occupied, that he could not think about anything else. One Sunday morning as he was going to church his hands were not engaged, but his mind was fully absorbed about the engine; a voice seemed to sound in his ears from someone beside him, "get another cylinder and carry the steam from the top and the bottom of the piston and condense it there with a spray or jet of cold water; your engine will go faster and be of much greater power, as the steam can be raised much higher by having a larger and stronger boiler;" everything seemed to be clearly marked out before him for a real steam engine to be used in factories, steamboats and land carriages. He became much excited over the vision in his mind, he could not follow the preacher in his sermon. A very great obstacle stood in his way, that was, the money it would cost to try his plans; he drew his plans and talked it over with Dr. Black, Dr. Roebuck, Dr. Ure and other friends, who agreed to assist him. He then withdrew from the University and devoted his time getting out his patterns and castings to get his engine to work. Here we had better let him carry out his plans, and we will observe him going from pattern to molding shops, machine to erecting shops, directing his workmen until his engine is finished and working. Dr. Roebuck and other friends provided the money and gave him room in the Carron Iron Works.

In summing up our standard of measure or unit we now call the horse-power. We must borrow an idea from Mr. Watt, and make our figures and calculations as simple as possible. I will now suppose the water in the mine to be about 206¼ feet to be drawn up, the bucket and rope to weigh about 125 lbs., and the water 287½ lbs., 28¾ gallons, or the whole 412½ lbs. The rope and bucket will descend by gravitation. The travel of the horse for the first draw will be 206¼ × 2 = 412½ feet, and if this be continued ten times per hour will give 4,127½ feet for the horse to travel and 4,127½ lbs. to draw, and if continued for eight hours a day, which is considered a day's work or the duty of a good horse, will give 33,000 lbs. drawn up over a pulley 33,000 feet or 6¼ miles per day. This gives 1 lb. to the foot, or as it is now called, a foot pound. If a horse could raise 33,000 lbs. one foot in a minute it would be considered a day's work, or the duty expected from him for a day's pay, as much as if he had taken eight hours. This is called the nominal horse power, and if a machine, steam or moved by any other force, can be made to do or exert that amount of force or work in one minute, or eight hours, it is called one nominal horse power, or if it can exert 100 horse-power in a minute it is called 100 nominal horse-power.

In bringing this subject to a close I think it wise to lay before you the cost of raising 33,000 lbs. or 2,300 gallons out of the mine 206¼ feet deep, and the horse has traveled 33,000 feet in eight hours. The horse should be well stabled and fed with an allowance of 25 lbs. chopped hay and a half a bushel of oats, beans and bran ground, about 40c. per day, a man's wages $1 for attending to it, and other expenses $1.50 per day. The first outlay equals about $300, interest $18.

In this paper we have seen a little into the workings of the steam and the atmospheric engine; in my next paper, if you, Mr. Editor, can find room for the little light I can bring before the readers of your valuable journal, I propose to follow our dear old friend, Jas. Watt, with his improvements, and trace down a little of what has been done since his death in 1819.

Yours truly,

P. T. TROWERN,

Feb. 15th, 1898. Chief Engineer Asylum for Insane, Toronto

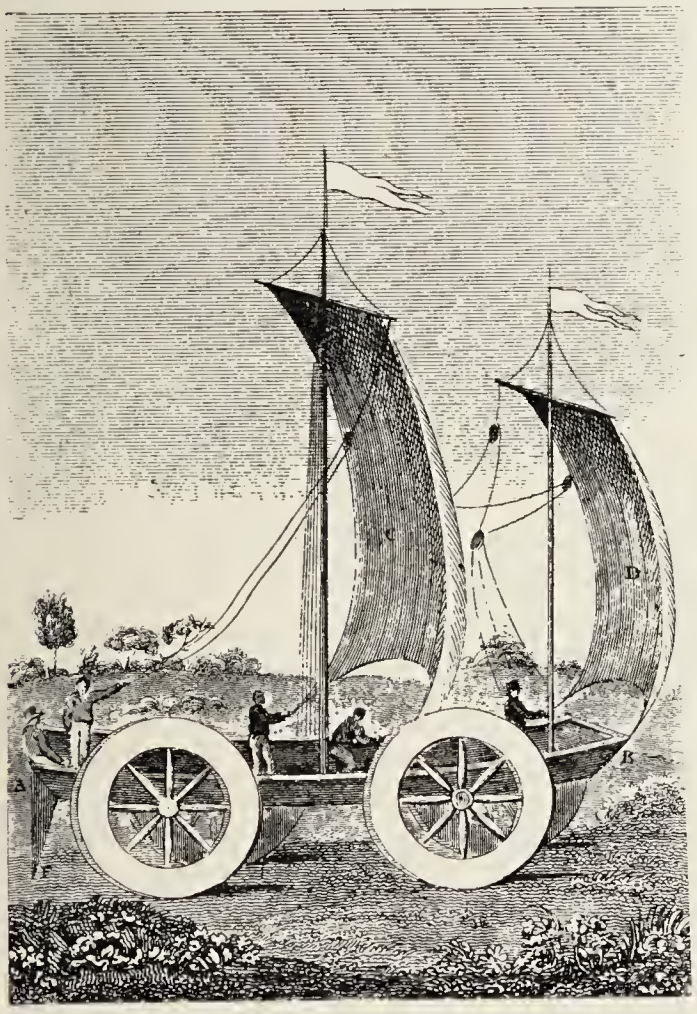
## THE MOTOR CARRIAGE.

PAST AND PRESENT.

"With the exception of lands and ruins, there are few material things of value to man which do not derive that value, in part at least, from transport from their original position Cheap means of transport is one of the most important of all the subjects occupying engineers to-day, and one which offers, as it has always done, one of the most profitable sources of investment."—Worby Beaumont, M. Inst. C.E., M. Inst. M.E., M. Inst. E.E., President of the Society of Engineers, England.

THE EARLIEST MOTOR CARRIAGE—1796.

The earliest motor carriage—a hundred years ago. The carriage shown was not strictly an autocar or automobile, but rather a manomotor, and the man who "moted" was in a double sense a footman. The pedals are crude bicycle pedals, therefore this curious old engraving represents the ancestor not only of the modern motor-carriage, but of the bicycle. As for the sailing chariot* or airmotor, the present-day prairie schooners would stand no chance in a cyclone-race with this Flying Dutchman. It was, too, picturesque, and had no massive storage batteries to be charged; no ponderous fly-wheels—though



THE SAILING CHARIOT.

This chariot was constructed in the last century by Stephinus, at Scheveling, in Holland, and would carry 8 or 10 persons from Scheveling to Putten, 42 English miles, in 2 hours. The wheels require to be farther asunder, and the axletrees longer than in ordinary carriages, to prevent overturning. Carriages of this kind are said to be frequent in China. In any wide level country their use must be sometimes both pleasant and profitable, when the wind is right.

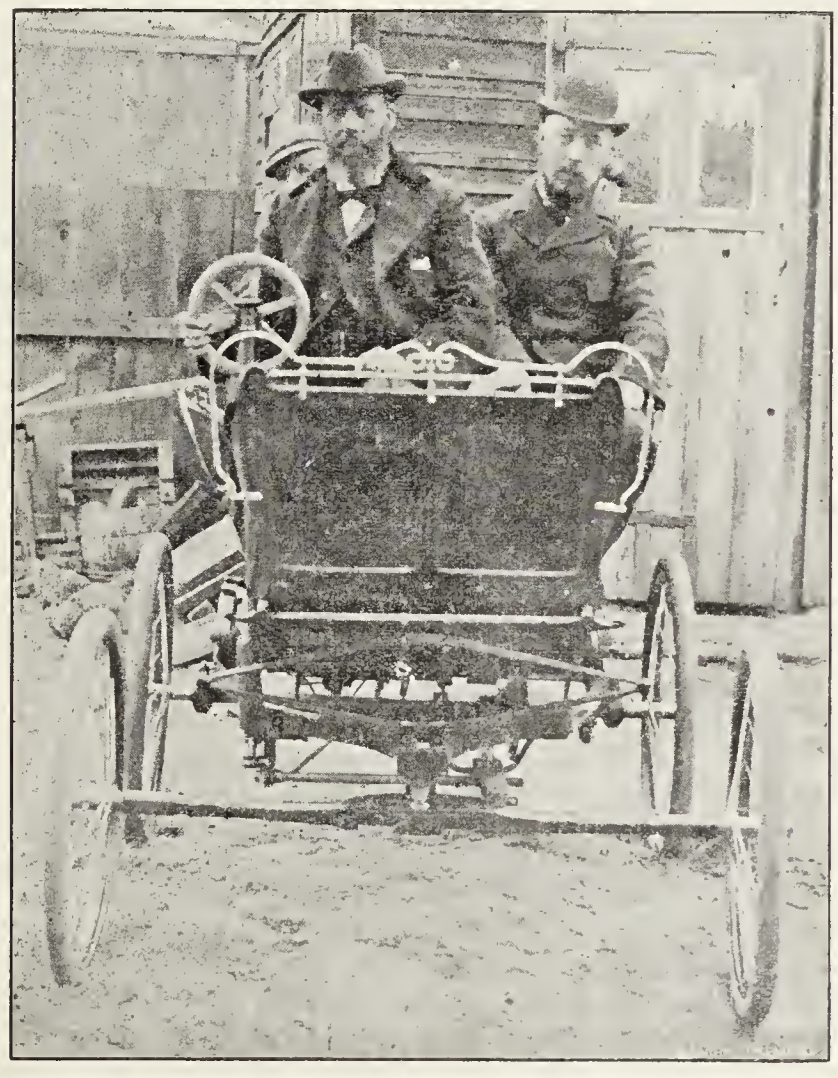
all four wheels fly; no water-jacket; no missing of explosions; no odors to offend the passers-by, or noise of escaping steam or exhausting gases to frighten horses. Of course if the wind happened to be in the wrong quarter, the ship simply lay-to and "waited the turn of the tide." So much for the past: these old engravings certainly mark the first definite attempts at the solution of the motor-carriage problem, and it is with pardonable pride THE CANADIAN ENGINEER presents them for the first time.

*For the engravings of the "Earliest Motor Carriage, 1798," and the "Sailing Chariot," we are indebted to Thomas Bengough, of Toronto, who, having the motor-mania, and being a book collector, recently captured the precious old volume containing the original engravings on steel.

What about the present? It is a time of unwonted activity among the inventors, engineers and mechanics. Thousands of the brightest brains in the world are struggling with the complicated problem of mechanical traction. Engineers who have made a special study of this question are aware of the peculiar difficulties it presents. That mechanical skill will finally triumph we firmly believe; and as seven cities claimed the honor of Homer's nativity, so will all civilized countries do homage to the genius who with seven-league boots shall stride in this mechanical Klondyke and show the world the way.

THE LATEST MOTOR CARRIAGE,—1898.

One of the most hard-working students of the motor problem is W. J. Still, who for nearly seven years has been experimenting in Toronto with the various types. The history of his failures would make interesting and profitable reading, but it is only of his success we have room to tell. Mr. Still's first experiments were with electricity, but although his work in this

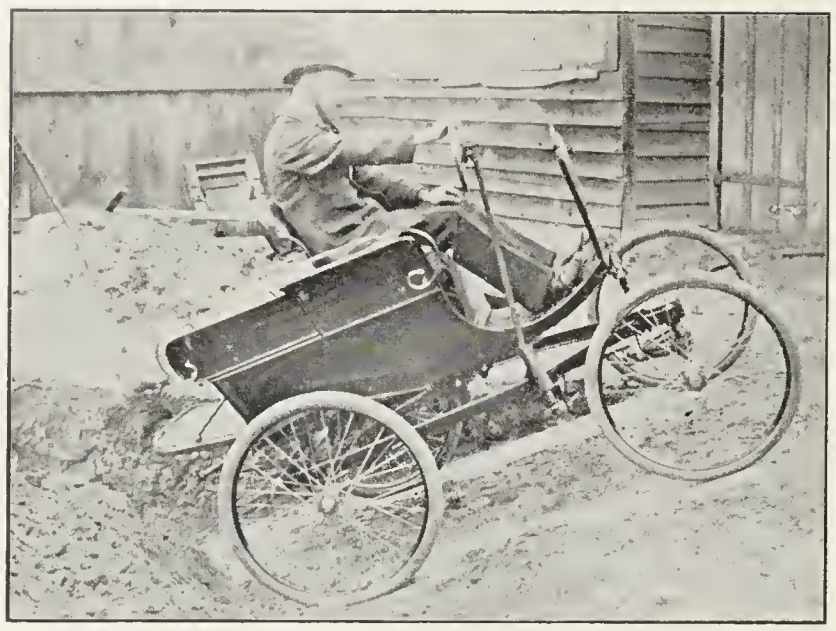


CANADIAN MOTOR CARRIAGE.

Front view, showing steering gear and controller. Hand wheel used for steering. Mr. Bengough at wheel; Mr. Still to his left. Weight of motor, 300 lbs. Entire weight of carriage (unloaded), 750 lbs. Power of motor, 5 h.p.

connection encouraged the young inventor, he fully recognized that electricity has severe limitations, the most serious of which is the absolute necessity for recharging. This consideration

alone puts the storage battery out of the race for running through districts where charging stations do not exist. Mr. Still's attention was therefore turned to gasolene engine construction, and following his radical bent, he determined to avoid altogether the weak points of all gasolene engines, viz., rapid piston movement, complicated cycles, and differential gearing: fo these features involve practically all the troubles that beset the motor carriages to-day. The sequence is made up thus:

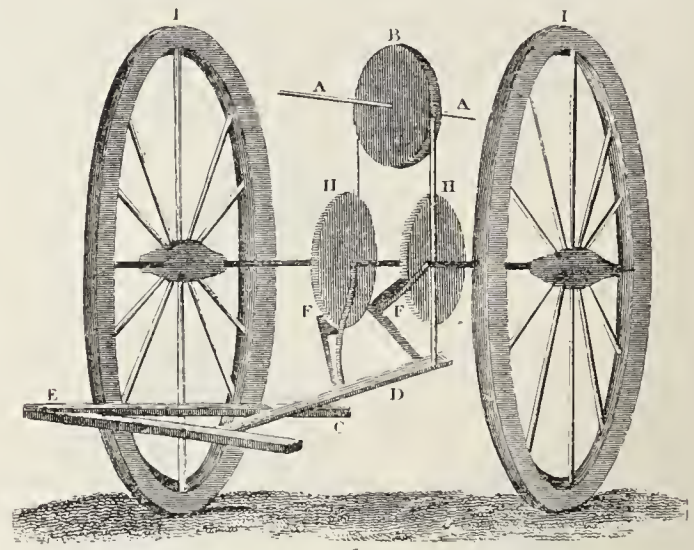


CANADIAN MOTOR CARRIAGE.

On grade specially constructed to scale of 1 in 3. As soil was soft, boards were laid for wheels so as to reduce tractive force and make test as severe as possible Brakes had not been fitted to rig when photo. was taken, and carriage is held in position by its own motive power.

(1) Rapid piston movement—600 to 1,000 revolutions per minute—causing immense heat, often up to 1,500 deg. or 2,000 deg. Fah.; this high temperature in turn necessitates the use of heavy oils, which at great heat give off bad odors. It also requires a water jacket and cooling water tank, with pipe system for circulation of water and radiation of heat. All these points involve great size, weight, and cumbrousness in proportion to load. (2) The complicated cycles, in which frequent misfires occur, involve very bad odor by the unused gas being emitted through the exhaust. The piston thus receiving no impetus, a heavy fly-wheel is essential, and this adds further weight and clumsiness. (3) The elaborate series of differential gearing add immensely to size, with no advantage except varying the speed of transmission. Sir David Salomons considers all differential gearing such a nuisance that he frankly says were he a manufacturer he would willingly give £20,000 to be entirely rid of it. Following on the heels of the heavy and complicated mechanical construction above noted, come noise and vibration. There also comes a loss of power in proportion to size and weight of mechanism. The highest record of power exerted by a motor carriage up to date was 187 pounds draw-bar strain, while the carriage (unloaded) weighed over 1,200 pounds. A good horse—such as Watt used to obtain his standard "horse-power"—will pull 400 pounds; therefore, 187 pounds is less than one-half horse-power.

To remove at one stroke all this complication, with consequent losses and disadvantages, was the herculean task to which the young inventor set himself. The essential point was to discover or invent a new cycle. There must be no "false motions" causing friction but resulting in no power. There must be no mechanical absurdity, such as is involved in the process of creating intense heat and then taking it away by a cumbrous round-about process of cooling. There must be a further feature superadded, which does not exist in any gas or gasolene engine; which exists in a limited area in the storage battery, which is found in perfect form in the steam engine: that feature being the ability to give off for short periods much more than normal power. In the case, for example, of the carriage referred to, 187 pounds would be easily sufficient to propel 1,200 lbs. on a level, but what would happen when a hill is reached? Sir David Salomons, one of the greatest, because most disinterested authorities on the autocar question, lays down this rule as to power of motors for carriages: "If twelve miles per hour be fixed as the speed of a vehicle weighing, when laden, say one ton, then the power of the carriage should be sufficient to run at this in all weathers and over all highways, and to climb every hill with a maximum ascent of, say, one in ten, at the proposed rate. The vehicle should also be able to mount a hill of one in five, but at less speed.....I have come to the conclusion that, for every ton, not less than ten horse-power should be carried." This, it will be noticed, is the exact proportion of power developed in the Canadian motor carriage. Sir David continues: "This does not necessarily imply that a ten horse-power engine is required. It means that the engine shall, for considerable periods, and without injury to itself, be able to give off 10 h.p. It must be remembered that when the carriage is started, a far larger amount of power is necessary than when it is running. It is therefore very important to have a good reserve." Sir David then quotes valuable figures to show the varying power needed according to the grade, taking




MECHANISM OF 1796 MOTOR CARRIAGE.

This carriage was exhibited in Paris, France, last century, by Dr. Richard, of Rochelle. When the footman presses down one of the treadles, suppose C, with his foot, he brings down one of the pieces of iron, F, and consequently turns the wheel H, that is next to it. At the same time, by means of the rope that runs over the pulley B, he raises the other treadle D, together with its piece F, which, being thrust down, will turn the other wheel H, and so alternately; and as the great wheels are fixed on the same axis, they must necessarily move at the same time.

PASSENGER AND PARCELS AUTOCAR

Now under construction by Canadian Motor Syndicate for the St Germain Autocar Line. Scale of drawing, ¼ in. = 1 foot. Van to seat 25 passengers; equipped with motors producing 20 h.p.; capable of ascending all grades up to 1 foot in 3; lighted by electric light; furnished with special indicator, for motorman; strong, effective brakes of two separate designs; seats to be handsomely upholstered; windows to have automatic spring roller blinds; roof railed for parcels.

a stage coach weighing 1,800 pounds, exclusive of passengers, thus :

| | | | | |
|---|---|---|---|---|
| Grade of | 1 in 40, | 6 miles per hour, | required .... | 160 lbs. |
| " | 1 in 30 | " | " ..... | 165 lbs. |
| " | 1 in 26 | " | " ..... | 213 lbs. |
| " | 1 in 20 | " | " ..... | 268 lbs. |
| " | 1 in 40, | 10 miles per hour, | requires.... | 172 lbs. |
| " | 1 in 30 | " | " ..... | 200 lbs. |
| " | 1 in 20 | " | " ..... | 318 lbs. |

On this point it may be interesting to quote from Mr. Worby Beaumont, whose quotation heads this article: "The increase in the power required to haul a load up a hill is directly proportional to the angle of inclination from the horizontal, and hence on a hill of one in twenty, a very common gradient, the hauling power jumps from the average, on a good macadam road, of say 45 lbs. per ton to 54 + 125 lbs., or a total of 157 lbs. instead of 45 lbs. Bad as this is, it is insignificant as compared with the pull required on a gradient of one in ten to one in eight, not at all unfrequently met with. On one in ten the hauling power required becomes 269 lbs. instead of 45 lbs., or no less than six times the power required on the average nearly level road. It is to meet this heavy demand for power that two or three horses have often to be sent with a load which, but for the one or two short lengths of steep hill, could be taken by one horse, and it makes it necessary to put on a motor vehicle boiler and engine power of from 12 to 16 horse-power, where from three to four horse-power would be sufficient."

Mr. Still set himself to solve this difficult problem, the peculiarity of which not even engineers understand who have not studied it in detail; for it must be remembered that the addition to a motor carriage of the boiler and engine power spoken of by Mr. Beaumont would in itself be fatal to the actual work of the motor carriage. Mr. Still's aim was to secure a draw-bar strain equal at least to one-half the total weight of the vehicle. His system is practically in itself a differential gearing of unlimited scope. It allows of a speed gear from the motor, beginning at the ratio of 1 to 1, and running to an almost unlimited scope, certainly over 120 to 1—the latter range having been actually reached in shop tests; this being entirely automatic according to the draw-bar strain required, and without any dividing line on either ascending or descending scale, and without belt, friction or gear-drive.

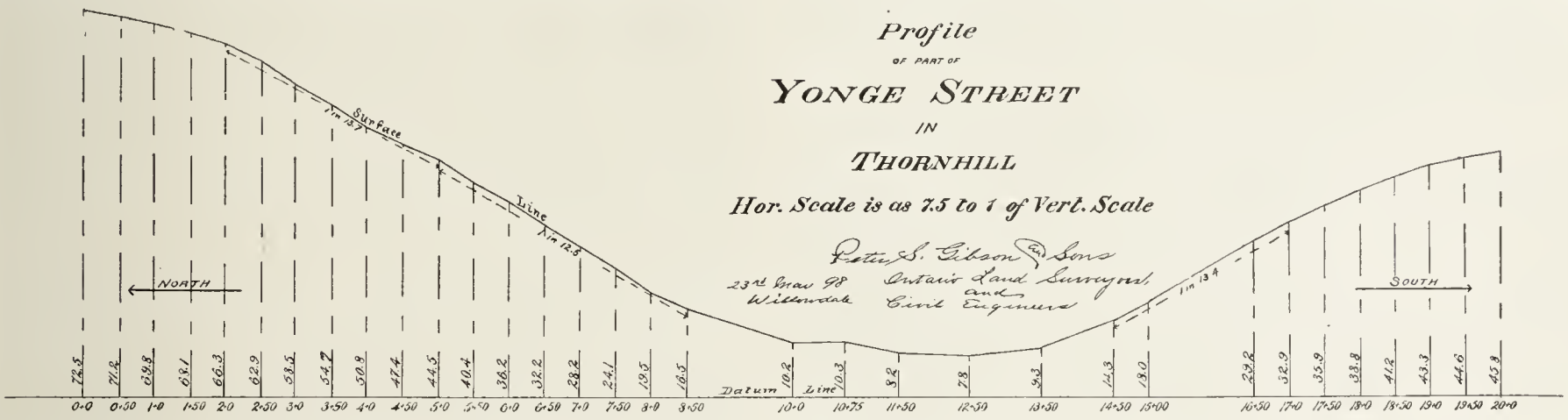
The Still system of motor power as it stands to-day, is unique in the fact of being able to place and maintain a rig in any desired position on any grade. This feature is admirably shown in the photograph representing the carriage standing on a grade of 1 in 3, the draw-bar strain being exactly proportioned to gravity and friction. No brake is involved in the operation: it is simply a question of a balance of the motive force; and about 20 lbs. in either direction would have overcome the balance and moved this rig, although at the time in question the outside draw-bar strain necessary would amount to about 270 lbs. This same force can also be used for sudden stopping in descending grades in case of emergency, and would not only stop a carriage, but rapidly propel it backwards the moment sufficient tractive force were obtained to stop the wheels from skidding. The control is simple. You simply push the controller forward if you wish to go forward; if you wish to go faster, you push it further forward; if you wish to stop, you pull the controller back: if you wish to reverse, a small lever, movable to the left hand, if pulled towards the rear, reverses the mechanism. This can, if necessary, be done at full speed without injury to the machinery. Steering is controlled by a handwheel on the controlling lever. Two separate powerful brakes are also provided, one operated by the foot and one by the left hand. Mr. Still's motor is a new departure. There is no sound of an exhaust; there is no odor of combustion, there is no heat; there is no necessity for the cooling water-jacket. In the rig as now standing, there is no water used or required. High speeds can be maintained, or the governor can be so adjusted that no speed above a certain maximum can be obtained, so that in case of delivery vehicles driven by careless Jehus, reckless driving will be impossible.

The motors used in this vehicle may be extended along the whole line, from a small bicycle unit to the unit necessary to drive ocean liners, including invalid chairs, all kinds of road vehicles, launches, street cars, railway engines and stationary engines.

It will be noted that the machinery in connection with the Canadian motor carriage is almost invisible, and not a line of the construction of the body has been changed. This carriage body is one of the regular make of the Canada Carriage Company, Brockville. Nothing has been done with it excepting that part of the flooring has been removed to allow room for the motor. The total weight of the engine is 300 lbs.; engine and truck together (including wheels), weigh 600 lbs.; the body of the carriage, controller and springs, add about 150 lbs., so that the total weight complete without load is 750 lbs. The load shown in the engraving (4 persons) is somewhat over 600 lbs. The carriage would easily accommodate its equal weight of load. Thus the proportion of weight to load is reduced to pound for pound, which is a reduction of about three-quarters of the ordinary weight of motor carriages. The power of this 300 lb. engine is equivalent to five horse-power. Thus the Canadian motor carriage combines the maximum power with minimum weight, and marks an epoch in motor carriage construction. A sudden development of the motor carriage industry in Canada has come within the past month. A. H. St. Germain, of North Toronto, has for over a year past been investigating the question of autocars, with a view of putting a service on the line between the city of Toronto and Richmond Hill, the service of the Metropolitan Street Railway up Yonge street—the main thoroughfare of the County of York—being very unsatisfactory. Mr. St. Germain is a wealthy gentleman, who lives at Bedford Park, about four miles north of the city, and he has personally suffered with others the inconvenience of the irregular service given by the Metropolitan Line. He had been corresponding with English autocar makers in reference to a number of storage battery omnibuses, but after having a private view of the Still engine as running upon the truck before the Gladstone carriage shown in the engraving was completed, Mr. St. Germain was convinced that his was the power he needed, and at once closed a contract with the Canadian Motor Syndicate, who control the Canadian business in connection with Mr. Still's inventions. This contract provides for the immediate construction of an autocar such as shown in the large engraving published herewith. This autocar is being constructed with all possible speed, and will take the road in the early summer. The following are the main features of the construction contract for the St. Germain autocar:

"Van to seat 25 passengers; equipped with motors producing 20 horse-power; capable of ascending all grades up to 30 per cent., lighted by electric light; furnished with buttons and special indicator by which motorman may be ordered to move to right or left boulevard, or stop suddenly; strong, effective brakes of two separate designs; seats on either side of middle aisle to be handsomely upholstered; windows to have automatic spring roller blinds; roof railed for parcels; everything to be of the best style and workmanship."

The route of the St. Germain autocar is a particularly difficult one, as can be seen by an examination of the profile prepared by the Township Engineer, Peter S. Gibson. It was



impossible to give in our limited space a profile of the whole line, covering ten miles, but a selection was made of one of the steepest grades, that near Thornhill. It will be seen by the figures upon the profile that this grade amounts to 8 and 10 per cent. These grades would require (as shown by the above extract from Mr. Worby Beaumont) a hauling power "six times that required on an average nearly level road." It must be remembered, too, that the conveyance which is to run over these immense grades is not an ordinary road carriage carrying from one to four people, but is a passenger and parcels van, seated for 25 persons, in addition to baggage on the roof. No such van is now running in any part of the world; and it speaks volumes for the courage of the promoters of the Canadian Motor Syndicate that they should be prepared to undertake such a task. Mr. Still, however, with an autocar equipped with his engines, capable of 20 horse-power, and being built also to exert this power much beyond the normal rates in times of emergency, is satisfied that the car will be able to surmount them without the slightest difficulty. The two motors, although small, will be placed immediately over or next the axles; every wheel will be a driving wheel, and the aggregate power which will be at the command of the motorman will be equivalent to 2,000 lbs. draw-bar strain—each of the motors being capable of 500 pounds draw-bar strain. This latter is the figure already reached in various tests of the motor with which the sma'l Gladstone carriage is equipped.

It is interesting to note in connection with the name of Mr. St. Germain, the promoter of the Pioneer line of Autocars, that the town of St. Germain in France, about 17 miles from Paris, had the honor of possessing the first railway in France; and true to its traditions, it was also the first to carry out trials of mechanical vehicles for public transport. A company has been formed in that ancient town to start a line of autocars between St. Germain and Ecquevilly, with a prolongation eventually to Nantes. Mr. St. Germain, although past the allotted three-score and ten, has shown great enterprise and enthusiasm in this matter, and is keeping the Canadian public posted constantly as to his proposed autocar service. He has purchased an interest in the Canadian Motor Syndicate, and to show his confidence and good faith in the enterprise, has on deposit the sum of $100,000 to invest in the autocar business.

The president of the Canadian Motor Syndicate is Thomas Bengough, court stenographer, Toronto; the mechanical engineer is W. J. Still, and the secretary is L. W. Dorling. At present writing, the business is being rapidly developed, patents having been applied for in all countries of the world covering the inventions of Mr. Still, and negotiations are in progress for increased factory accommodation.

## CANADIAN ASSOCIATIONOF STATIONARY ENGINEERS.

On March 8th, Inspector St. John, of the Boiler Inspection and Insurance Company, delivered an interesting and instructive lecture before the Toronto No. 1 C.A.S.E., on the strength of materials in boilers.

The regular meeting of Toronto No. 1, Wednesday, March 16th, was one of the best held this winter. The question box was full, and Bros. Fox, Barman, Mosely and Wickens took part in answering in a very full and instructive manner.

The Hamilton branch of the C.A.S.E. held an open meeting recently in their hall. Quite a large number of the members attended and although through some misconception no regular paper was read some very interesting questions dealing with boilers, engines, machinery, etc , were discussed. In answer to one question as to whether more fuel is used in running two small engines instead of one large one, it has been proved that a large engine of, say, 150 horse-power uses considerably less fuel than two of 75 horse-power. This is owing principally to the fact that more heat is carried off in radiation in using the two than in the one. In cases of electric light plants, power houses, etc., it is often desirable to have two small engines instead of a large one, so that if anything happens to one the power need not be stopped as they will have the other to fall back on. The annual banquet of the Hamilton branch will be held in April.

At a meeting of the London branch C.A.S.E., held in Sherwood Hall recently, a lengthy discussion took place on Electric Motors and Steam Boilers, in which all members took part. Some time ago a pamphlet was issued by the examining board, Messrs. Risler, Bright, Goldart and McLean, with a number of engineering questions to be solved. Two prizes were offered for the best answered paper. D. J. Campbell was awarded first prize, $8, and D. McKinley second, $5.

# Industrial Notes.

YARMOUTH, N.S., is to have a $12,000 school building.

THE village of Hintonburg, a suburb of Ottawa, is to have waterworks.

M. MOORE, Chatham, Ont , purposes to start a canning factory in Berlin, Ont.

A LARGE saw mill is to be erected at Tusket Wedge, N.S., by J. H. Pothier & Co.

TENDERS are being asked for the building of a waterworks system in Port Colborne.

ST. PATRICK'S CHURCH, Ottawa, Ont., is to be improved this year at a cost of $50,000.

PLANS are being prepared for a new Y.M.C.A. building at Winnipeg to cost $50,000.

THE Guelph, Ont., Foundry Co has been organized to manufacture hot air furnaces.

WM. MCKENZIE, Toronto, has become a director of the Calcium Carbide Co., St. Catharines.

A MONTREALER interested in the iron trade is negotiating to buy the Kingston Locomotive Works.

A BUILDING permit has been taken out for a brick addition to the Greening Wire Works, Hamilton.

M. BEATTY & SONS shipped two hoisting engines to Ryan & MacDonald, Dominique, Que., recently.

CITY ENGINEER BARROW, Hamilton, Ont., has planned an $18,000 trunk sewer, to be built this summer.

THE Canadian Typograph Co., Windsor, Ont., has shipped 400 bicycles to South Africa this season.

G. BROWN, Westmeath, Ont., is building the bridge across Coulonge River, near Coulonge, Que., at $6,000.

AT the annual meeting of the Belleville, Ont., Gas Co., on the 12th ult., J. W. Johnson was elected president.

I. USHER & SONS are putting in a new one hundred horse-power engine in their cement mills, at Queenston, Ont.

THE filters installed in the Renfrew, Ont., water-works by J. McDougall, Montreal, have been successfully tested.

THE Wm. English Canoe Company, Peterborough, Ont., shipped twenty-four canoes to the Yukon in one week recently.

T. L. WILLSON, of the Calcium Carbide Co., Merritton, Ont., will, it is said, build large works near Montmorency, Que.

BLONDE BROS., Chatham, Ont., will build the Kent County House of Refuge at their tender of $14,421 for the building complete.

THE Columbia Handle Company, Thamesville, Ont., has moved its plant to London, Ont., and is located in the old London East G.T.R. freight sheds.

THE Massey-Harris Co., Limited, Brantford, Ont., will spend $25,000 on enlargement of their works, and will also greatly enlarge the Toronto factories.

THE Hamilton, Ont., Blast Furnace Company during the past winter took three thousand tons of iron ore from the township of Darling, Lanark county, Ont.

FREE instruction will in future be given in sheet metal pattern cutting in the rooms of the Sheet Metal Workers' Union, Toronto. All sheet metal workers of the city are invited to attend.

J. L. GOODHUE & Co., belt manufacturers, Danville, Que., are completing a number of large belts for a new mill on the Pacific coast, consisting of one 48 feet double, two 20 feet double, two 18 feet double, and the smaller belts required.

ARTHUR DENISON, architect, Toronto, has taken out a permit, on behalf of the Cawthra estate, for the erection of a $50,000 store building, to be erected according to his plans on the old John Eaton Co.'s site, corner of Yonge and Temperance streets, Toronto.

E. GOFF PENNY, R. Prefontaine, J. A. C. Madore, Montreal; N. A. Belcourt and F. McDougall, Ottawa, are applying for a Dominion charter as the Canadian Agricultural Utilization of Sewage Water Company, Ltd., having its chief place of business in Montreal, with a capital stock of fifty thousand dollars.

AN important students' organization came into existence at a recent meeting of the students of engineering at McGill University. It is the Applied Science Technical Society of McGill University. The special importance of the organization is that it will unite together not only the students at college but the graduates of the faculty.

D. McGillivray, Fort Steele, B.C., has received the contract for the bridge work on the Crow's Nest Pass Railway from Crow's Nest Lake to Moyie Lake, 200 miles.

Goldie & McCulloch, Galt, Ont., shipped recently six carloads of sawmill machinery, including six boilers, for the Crow's Nest Pass Railway Construction companies.

A company will build a charcoal iron smelter in Deseronto, Ont., on condition that the Rathbun Co. take 25 per cent. of the output, and that the town gives a bonus of $25,000.

An acetylene gas generator exploded in a house in Oshawa recently, doing damage. The machine was blown to pieces, the top being blown upward, making a hole through the ceiling.

The molders at the Waterloo Manufacturing Co.'s foundry have gone out on strike, there being a difference between the manager and the molders regarding what the latter considered a fair day's pay.

The Tisdale property, Brantford, Ont., which has been vacant for several years, will be occupied by the Chalcroft Screw Company, which will be engaged in the manufacture of screws, nuts and bolts.

J. Stuart, foundryman, St. Catharines, Ont., recently cast what is said to be the largest bevel gear ever cast in one piece in Canada. It will weigh four tons; the gear will be used in the Riordon Paper Mills.

At the annual meeting of the Hamilton Iron Mining Company, John Milne was re-elected president, and the old board of directors was also re-elected. The company declared a dividend of 6 per cent. on the year's business.

The New Glasgow Steel Works may go to South Bar, C.B. It is stated that the Dominion Coal Co. are favorable to the erection of the works there, and that they are offering the Victoria pier at a very small sum, and free coal for a certain time.

The Goold, Shapley & Muir Company, Brantford, Ont., who recently had their factory destroyed by fire, have decided to stay in Brantford. The city council has given them the old Verity building for twenty years at a nominal rental of one dollar per year.

Robert Brick, who has been in charge of the tool-making department of the Canada Screw Works, Hamilton, for about a year and a-half, has gone to Vancouver, where he has secured a good position with the Automatic Can Company.

The Portland Rolling Mills Company, Limited, at the annual meeting elected the following board of directors, viz.; J. C. Robertson, president; S. Hayward, vice-president: James Mowat, sec.-treas.; Joseph A. Likely, W. H. Murray, and George F. Baird.

The Bushnell Oil Company are bringing in the machinery of their Petrolia, Ont, refinery to Sarnia. The Petrolia premises will hereafter be used only as a receiving station. The Bushnell Company is having a large number of underground tanks put down on its property in Sarnia.

J. Allison, W. H. Murray, T. McAvity, G. F. Baird, G. S. Cushing, G. McKean and James Fleming, Saint John, N.B., are applying for a New Brunswick charter as the Cushing Sulphite Fibre Company, Limited, chief place of business, Fairville, N.B; capital, $50,000.

St. Thomas is to have a brass foundry, which will be established by the Messrs. Jewett, fonndrymen, of Buffalo, N.Y., who have made arrangements to supply the Michigan Central, the Wabash and the Grand Trunk Railways with all the brass fittings they require, and will also do a general business.

At a recent meeting of the Quebec Bridge Company, Mayor Parent reported that the statutory capital of the company, $200,000, was now more than fully subscribed, that the borings in the bed of the river were progressing satisfactorily and the bridge plans had been approved by the chief departmental engineer at Ottawa.

Vincent & Dufresne, civil engineers, St. James Street, Montreal, have a contract for a light portable dredging plant, to be equipped with engines to be run by acetylene gas. Builders of generators for this gas, and makers of suitable engines, should communicate with above firm at once. The experiment will be an interesting one, and the results will be carefully watched for.

The seekers after the treasure buried at Oak Island, N.S., are making progress. They are now sinking a shaft to be used as a pumping shaft, and when a depth of 180 feet is reached they will set up pumps and drive a tunnel toward the drain that leads into the "money pit" from the shore and takes the water out by way of the new pit. While sinking this pit they were doing some prospecting with a drill, and struck iron at 125 ft., 126 ft., 152 ft., 165 ft. and 170 ft. At the 153 feet depth they went through an oak box full of metal of some kind and brought up from it a small piece of parchment. This box is bedded in a cement analyzed and found to be composed of lime and sand.

J. R. Booth, Ottawa, will build a 300 barrel flour mill in Ottawa.

A. Gagnon, Victoriaville, Que., is adding one of the Jenckes Machine Co.'s standard boilers to his equipment.

The Dominion Paper Co., Kingsey Falls, Que., is setting up a new wet machine, one of the Jenckes Machine Co.'s standard 72-inch wet presses, shipped them a week or two ago.

A. F. Bury Austin, Montreal, has secured the contract to supply all the dimension timber, white pine and hemlock, for both the understructure and bridge flooring of the new interprovincial bridge at Ottawa.

Joseph Guilbert, of Windsor Mills, Que., is making extensive additions to his saw mill, and has placed an order with the Jenckes Machine Co., Sherbrooke, for a large quantity of shafting, log-handling apparatus, etc.

W. W. Lee Chance, architect, Hamilton, Ont., has prepared plans for a steel frame canning and evaporating building for J. W. Van Dyke, Grimsby, Ont. The building will be 45 x 160 ft., without columns, and two stories high.

Incorporation has been granted to W. C. Fox, T. H. Graham, E. Buffum, F. G. Bowers, D. G. Lorsch, H. B. Latimer and J. R. Shaw, Toronto, as the Frontenac Lead Mining and Smelting Company, Limited; capital, $55,000.

The correspondence system of education in technical subjects, as carried on by the International Correspondence Schools, of Scranton, Pa., is one of the most successful plans ever devised for giving thorough, practical education to wage earners.

The Jenckes Machine Co., Sherbrooke, Que., is furnishing the Canadian Rand Drill Co. with a handsome compound Corliss air compressor weighing some 33 tons, together with accompanying apparatus, bringing the total weight nearly up to 40 tons.

Steps are being taken by T. L. Willson, president of the Calcium Carbide Company, to enter an appeal against the judgment of Magistrate Hall, convicting his men of a breach of the Lord's Day Act in the recent trial for working on Sunday, as mentioned in our last issue.

City Engineer Barrow, of Hamilton, has recently made some interesting experiments in sewage filtration on the lines laid down in different numbers of The Canadian Engineer. One of his experiments which was very successful was made with slack coal as a filtrate.

William McVicar, McVicar, Ont., is putting in a Dake Steam Feed, built by the Jenckes Machine Co., Sherbrooke, Que., with whom the Phelps Machine Co., of Eastman, Que., formerly Canadian manufacturers of the Dake engine, has amalgamated.

The Dominion Radiator Co. is being incorporated to take over the business of the Toronto Radiator Manufacturing Co.; capital, $300,000; directors are as follows:—Jos. Wright, D. Carlyle, J. Stark, J. M. Taylor and C. T. Stark, Toronto.

Incorporation has been granted to the Tree Rotary Engine Company, of Woodstock, Limited, to manufacture and sell Tree's Rotary Engine, and, for the said purpose, to acquire Dominion of Canada letters patent number 55,616 and number 56,806; capital, $24,000.

The waterworks system of Barrie, Ont., has been valued for arbitration purposes by E. Vanier, C.E., Montreal, at about $110,000, and by Willis Chipman, C.E., at $53,770; and E. H. Keating, C.E., Toronto, at $52,369. These figures are the estimated cost, less the speculative depreciation in seven years.

Galt, Ont., manufacturers are enlarging their establishments this year. The Goldie-McCulloch Co. is erecting new offices and intends to add to its present molding shop. The R. McDougall Co. Limited, is also contemplating extensive improvements to its foundry, and the C. Turnbull Co. will put up a mill on the site of the W. S. McKay factory.

The Royal Paper Mills Co. has recently added a complete rope drive to the transmission machinery at the East Angus, Que., mill. This was furnished by the Jenckes Machine Co., Sherbrooke, which is furnishing the entire tank work, together with the accompanying machinery. East Angus presents a scene of great activity, carload after carload of material arriving and being placed in position. When completed, this mill will take a prominent place among the producers in the pulp and paper trade.

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**THE PUBLISHERS.**

WILLIS CHIPMAN, C.E., has made a report to the London, Ont., city council, favoring the establishment of a sewage farm instead of running the sewage into the river as at present.

CITY ENGINEER MITCHELL, of Niagara Falls, Ont., has made a survey of the Niagara River bank both at the top of the cliff and the water's edge between the cantilever bridge and the whirlpool, for the park commissioners, who are preparing preliminary surveys of the water power facilities at the rapids.

# Railway Matters.

F. B. WADE, Bridgewater, N.S., is applying for a charter to build a railway from Shelburne to Halifax.

THE Pennsylvania Steel Co., Harrisburg, Pa., will build sixteen bridges for the Grand Trunk this summer.

THE plans have been prepared for the new C.P.R. shops at Revelstoke, to which place the shops at Donald will be removed.

THE C.P.R. will build a new depot at Vancouver, B.C. This with wharves and other buildings, entail $300,000 expenditure.

ALEXANDER MCGREGOR has been sent out by the Dominion Atlantic Railway Company of London, Eng., to act as superintendent at Yarmouth, N.S.

F. R. F. BROWN, mechanical superintendent of the Intercolonial Railway, has been removed from his position and will, it is understood, open an office in Montreal as a consulting engineer.

THE Canadian Pacific Railway has done such a large grain business from St. John, N.B , this season that it has been decided to build another elevator there, and the plans are being got ready for a new one, which will be of 800,000 bushels capacity.

DR. KING, vice-president, and Superintendent Woollat, of the Lake Erie and Detroit River Railway, have made a trip over the proposed extension of the L. E. & D. R. R. from Ridgetown to St. Thomas, Ont. The latter town will probably give a bonus of $20,000 to the extension.

THE Canada Atlantic Railway Company is applying for power to construct an extension from some point on the line of the company on or near the River Richelieu, in the county of Missisquoi, in an easterly direction to a point on the international boundary line in the county of Missisquoi, or in the counties of Brome, Stanstead or Compton, so as to form a connection with the railway systems of the United States, and also from some point on present line near the St. Lawrence River or north-westerly therefrom, through the counties of Soulanges and Vaudreuil, crossing the Ottawa River near the Village of St. Anne, and to some point in the City of Montreal, by the most feasible route to the St. Lawrence River, at some point in or below the said city.

THE report of the Grand Trunk shows the net revenue surplus for the half year ending December to be £275,263, being an increase of £236,117 over the corresponding period last year. Passenger earnings decreased £151,728, compared with 1896. The tons of freight and live stock have increased 410,960. The earnings per train mile have increased fourteen cents, and the working expenses have decreased nearly seven per cent. The Chicago and Grand Trunk shows a deficit of £49.467, being £17,900 better than in 1896. The Detroit and Grand Haven shows an increase in net revenue of £21,373, leaving a net deficit of £2,174 on revenue charges. The directors report the agreement granting the Wabash Company joint use for 21 years of that portion of the Grand Trunk between Windsor and Black Rock station.

THE Governor of Newfoundland, Sir Herbert Murray, has signed a railway contract with R. G. Reid of Montreal. The Government claims that the arrangement will effect a saving of $80,000 a year in addition to promoting the development of the country. Mr. Reid has contracted to build a railway across the island and to work the entire railway system of 650 miles for 50 years, receiving a subsidy of 2,500 acres of land per mile. He pays $1,000,000 now, which will become $7,000,000 at the end of the period, when the colony takes the money and the contractors will take the railway. If he should make default in carrying out the contract during the period, both the money and the railway are forfeited to the colony. Mr. Reid purchases St. John's dock for $350,000, and the Government telegraph lines for $125,000. He also undertakes to build seven mail steamers to ply in the Great Bays, receiving a subsidy of $100,000 for thirty years. The contractor secures also certain coal areas which he agrees to work, as also pulp and lumber mills and copper and other minerals, being protected by a dollar duty to be imposed on imported coal. Furthermore he contracts to build an electric railway in St. John's, and tc pave the main streets of the city for $140,000.

THE management of the Grand Trunk Railway system has contracted with the Pullman Company, Chicago, for the construction of twenty first-class passenger coaches. They will be turned out with every modern improvement. The Grand Trunk is just finishing the construction of two hundred freight cars, and have decided to build three hundred coal cars in their Canadian shops. In addition, ten new locomotives have been received from the Baldwin Works, and ten more are coming from the Schenectady Works. The C.P.R. is also making the addition of some fifty-five cars to the already large supply used by the great Canadian trans-continental line. Ten of them will be sleeping cars, twenty of them first-class passenger coaches, ten tourist cars and five baggage cars. All, except the tourist cars, are being built at the company's shops, Niagara Falls, Ont., the Crossen Works at Cobourg having the contract for the tourist cars.

**MOVING TIME!! Subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses.**

**THE PUBLISHERS.**

# Electric Flashes.

W. MOORE & SONS have renewed their lighting contract with Meaford, Ont.

THE Perth, Ont., Waterworks Co. is installing two phase "S.K.C." motors.

THE Montreal Street Railway Co. has received an order for 20 motor cars from Kingston, Jamaica.

C. FRASER has succeeded Electrician Brown in office at the H., G. & B. power-house, at Stoney Creek, Ont.

ARKONA is said to be willing to give a $10,000 bonus to the proposed electric railway from London to Lake Huron.

PETERBOROUGH, ONT., is discussing a bonus of $1,000 a year for 20 years for a radial railway taking in the lake district.

HENRY MORGAN & Co., Montreal, have placed an order with the Royal Electric Co. for a 20 K.W. direct current generator.

THE Brantford, Ont., Electric and Operating Co. is installing a 60 K.W. "S.K.C. and a 40-light T-H Arc machine received from the Royal Electric Co.

IT is reported that the Quebec Electric Street Railway will extend its line from the city to Cap Rouge via the St. Louis road, and returning by the St. Foye road.

ARRANGEMENTS have been completed by which the extension of the lines of the Montreal Street Railway into the village of Verdun, are assured for the coming summer.

OWING to ill-health, John McDermott, who has been in charge of the Almonte Electric Light Company since it was formed, has retired from active work.

NEGOTIATIONS have been commenced with a view to construct an electric railway between L'Epiphanie and Joliette, Que., passing through the parish of St. Jacques de L'Achigan.

THE projectors of the Hamilton, Chedoke & Ancaster Radial Electric Railway, propose to extend it to Brantford, and are vigorously pressing the matter with the municipalities most concerned.

W. J. FLETCHER, Markham, Ont., proprietor of the electric light plant there which was recently destroyed by fire, has decided to reconstruct the plant, and has purchased from the Royal Electric Co. a 20 K.W. "S.K.C." generator.

LAST year the Galt, Preston and Hespeler Railway carried 221,647 passengers, an increase of 2,627. The total freight carried was 12,973 tons, an increase of 4,663 tons. The increased earnings was $1,900. President Todd has been re-elected.

THE C.P.R. management is experimenting with a system of electric light generated from the axles of moving cars, and the results are said to be very promising. Storage batteries are used. The "Winchester" is the first with the new electric system.

THE long-standing litigation over the assessment of the poles, wires and tracks of the Toronto Railway Company has been settled by the Court of Appeal giving judgment in favor of the city of Toronto. By the decision, the assessment of $452,277 against the company in Wards two to six is confirmed for 1898, which will probably yield between $7,000 and $8,000 in taxes.

TORONTO and Hamilton, Ont., are both agitating the question of municipal lighting plants. Tenders will, probably, be called for in each case; but only in order to determine prices for purposes of argument.

THE Shipton Electric Light and Power Co., Danville, Que., has received a Crocker Turbine from the Jenckes Machine Co., Sherbrooke, which is proceeding with the installation of the same with penstock and draft tube.

THE report of the U.S. commissioner of patents for the year 1897 shows that to residents of foreign countries the number of patents issued were: England, 706; Canada, 286; Germany, 551, and France, 222. The most noted are those connected with the development of electrical inventions.

T. E. MCLELAN, the courteous and obliging manager of the Berlin and Waterloo, Ont., Street Railway, has resigned his position to go to the Klondyke. He will be succeeded by H. H. Hilborn, E.E., of Montreal, who, since his graduation from Cornell, has been in the service of the Montreal Street Railway Co.

THE Halifax Electric Tramway Company, Limited, has just installed two large generators, each having a capacity of 6,000 sixteen-candle power lamps, which, together with generators previously operating, make the capacity of the company 18,000 sixteen-candle power lamps. There is no ground, the company states, for the rumor of the amalgamation of the company with the People's Heat and Light Company.

THE transfer of the Quebec District Railway from the present company to the new one formed by H. J. Beemer, will take place before July 1st. New open cars for summer use have been already ordered. Meanwhile the changing of the steam system to electricity on the line of the Quebec, Montmorency and Charlevoix Railway will be proceeded with. Most of the cars now in use upon the road will be run as electric cars with one, two or three trailers, as necessity may arise. It is the intention to run electric trains to Ste. Anne about every hour. About the whole amount of the capital stock of the new Quebec Electric Railway Company has been underwritten.

## Personal.

MORGAN BALDWIN, harbor master, Toronto, died last month at his residence in that city.

THEO. ZWICKER, machinist, has now charge of the machine shop at the Halifax dry dock.

S. S. FOLEY, Chapleau, Ont., has been appointed despatcher on the Crow's Nest Pass Railway.

ED. S. FRASER, C.E., New Glasgow, N.S., has taken a position on the staff of the South Shore Railway.

JAS. W. MILNE, formerly of the Waterous Engine Works Co., Brantford, Ont., has gone to Vancouver, where he will represent a Montreal firm.

ENGINEER HUTCHINSON of the G.T.R., who was badly burned in the railway accident at Burlington, Ont.. died at the Hamilton Hospital, March 4th.

ARCHITECT ADAMS, of the Kingston Penitentiary, has been suspended from duty on a charge of insubordination preferred by Deputy Warden O'Leary.

H. GARDNER SMITH, the new engineer of the D.A.R. steamer "Prince Edward," has arrived at Yarmouth, N.S., from England and entered upon his duties.

R. G. MCCONNELL, of the Dominion Geological Survey, has accepted the position of mineralogist of the Province of British Columbia, to succeed W. A. Carlyle, who resigned.

THE death occurred at Truro, N.S., last month, of Wm. Yould, sr., assistant trackmaster of the I.C.R., aged 78 years. He was the first foreman of tracklaying on the Nova Scotia Railway, now a part of the I.C.R.

RAOUL RINFRET, C.E., of Montreal, who is going to the Yukon with the Slavin-Boyle party, has been commissioned by Minister Sifton to organize a meteorological service in the Yukon country, as well as to make certain surveys for the Interior Department.

THE well-known contractor, John Ross, died very suddenly at Lancaster, Ont., March 12th. He was very successful as a railway contractor, and very wealthy. It is said of him that he built more miles of railway than any other contractor in America. He was 78 years of age.

ALBERT ROBINSON, formerly of Crowe's Iron Works, Guelph, Ont., and lately of Detroit, has been made foreman of the Cossitt Works, Brockville, Ont.

JOHN GALBRAITH died recently in Brantford, Ont., from blood poisoning. Deceased had been employed for the past ten years as boiler-maker at the Waterous engine works. A few weeks ago he got his foot badly bruised with a heavy piece of iron, from the effects of which blood poisoning set in.

JAMES M. MACOUN, who has interested himself in the Behring Sea investigation for some years, has, in recognition of his services been appointed by the Government assistant naturalist of the Geological Survey. He has been on the temporary staff of the Geological Survey since 1883.

THE death of W. M. Hamilton, recently, removes an old resident of Toronto. Mr. Hamilton had been for the last year manager of the St. Lawrence Foundry, but from 1885 to 1893 he was superintendent of the Parkdale Waterworks Department, but resigned when it was amalgamated with the city.

SIR HENRY BESSEMER, the celebrated inventor of Bessemer steel, died in London, March 15th. Deceased was an eminent engineer, born in Hertfordshire, England, in 1813, he early devoted himself to the improvement of machinery, and acquired celebrity by his invention of a new practical process for the manufacture of steel, which was extensively adopted in Europe and America, and the product of which is known in trade as Bessemer steel.

CECIL B. SMITH, Ma.E., A.M., Mem. Can. S.C.E., who has just resigned his post at McGill, to take a position on the engineering staff of the C.P.R., was born at Winona, near Hamilton, March, 1865, and received his education at the Hamilton Collegiate Institute, and afterwards in civil engineering at McGill University, graduating in 1884 with first honors and the Governor-General's medal. Since that time he has been engaged chiefly on railroads, although working for a short time under Mr. Thomas Monro on the Welland Canal, and under Mr. John Kennedy on the Montreal Harbor Commission. He has had charge of many heavy pieces of construction; on the Northern and Pacific Junction Railway under Mr. J. C. Bailey, on the St. Catharines and Niagara Central Railway under Mr. B. N. Molesworth, on the C.P.R. at London, Ont., under Mr. W. T. Jennings; surveyed for the Toronto, Hamilton and Buffalo Railway during the summer of 1889, under Mr. A. L. Hogg. He was then appointed successively: resident engineer, chief draughtsman and division engineer on the C.C. and C.R.R. in Tennessee and S.C. under Mr. A. N. Molesworth, constructing 70 miles in all. He was then appointed division engineer on the Roanoke and Southern Railway, under Mr. Andrew Onderdonk, in charge of 65 miles of heavy work, including track-laying and maintenance. On this being completed, after short reconaissances for the Concord Southern Railway, he was appointed resident engineer on the Baltimore and Ohio Railway, under Mr. W. T. Manning, in charge of 14 miles of very heavy work. On completion, he was appointed Lecturer in Civil Engineering and Descriptive Geometry at McGill University, the duties of the former belng to lecture in railway engineering and on testing of materials of construction. In 1888 he was made associate M.C.S.C.E., and in 1894 obtained the degree of Master of Engineering from McGill University. On the occasion of his resignation from the faculty of applied science, McGill University, Professor Smith was the recipient of a beautifully engraved walnut case containing two very valuable aneroid barometers, with kindest expressions of regard and regrets at his withdrawal from the university, on behalf of the undergraduates of 1898 and 1899 of the faculty of applied science. The interesting series of papers from Mr. Smith's pen which have appeared in the CANADIAN ENGINEER during the past year will be continued in next year's volume. The articles which have already appeared are now ready to be issued in book form as "Railway Engineering," Vol. I.

## Marine News.

Edwardsburg Starch Co., Cardinal, Ont.: Steamer—Rosedale, Capt. Jas. Ewart, Engineer E. O'Dell.

Myles' Sons, Thomas, Hamilton, Ont.: Steamer—Myles, Capt. John S. Moore, Engineer Jas. Smeaton.

Sylvester Bros., Toronto, Ont.: Steamer—Eurydice, Capt. J. Jackson, Engineer Alex. Munro. Schooner—St. Louis, Capt. Geo. Williamson.

Merchants' Line, G. E. Jacques & Co., Montreal: Propellers—Cuba, Capt. Robert Chestnut, Engineer Wm. Kennedy; Melbourne, Capt. Hy. Chestnut, Engineer, Thos. Milne.

J. B. Miller, Toronto, Ont.; Steamer—Seguin; Capt. J. B. Symes; Engineer, Samuel Gillespie.

Fairgrieve & Co., J. B., Hamilton, Ont.: Steamer—Arabian, Capt. Oliver Patenaude, Engineer Alex. H. Bertram.

Conlon, J. & T., Thorold, Ont.: Steamer—Erin, Capt. P. Sullivan, Engineer J. Dawson. Schooners—F. L. Danforth, Capt. John Cornwall; Maggie, Capt. John Rosie.

North-West Transportation Co., Sarnia, Ont.: Steamers —Monarch, Capt. E. Robertson, Engineer E. W. McKean; United Empire, Capt. John McNab, Engineer S. Brisbin.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston, Ont.: Steamers—North King, Capt. John Jarrell, Engineer O. J. Hickey; Hero, Capt. Wm. Bloomfield, Engineer John McEwan.

Canadian Pacific Steamship Co., Owen Sound, Ont.: Steamers—Manitoba, Capt. E. B. Anderson, Engineer R. Chalmers; Alberta, Capt. J. McAllister, Engineer A. Cameron; Athabasca, Capt. G. McDougall, Engineer W. Lockerbie.

McKay, R. O. & A. B., Hamilton, Ont.: Steamers—Sir S. L. Tilley, Capt. Geo. Mackey, Engineer Jas. H. Brown; Lake Michigan, Capt. Wm. O. Zealand, Engineer Jos. Boulanger. Schooner—T. R. Merritt, Capt. Wm. A. Corson.

Niagara Navigation Co., Jno. Foy, Manager, Toronto, Ont.: Steamers—Chippewa, Capt. J. McGiffin; Engineer, R. McCaul; Corona, Capt. W. H. Solmes, Engineer I. Walsh; Chicora, Capt. R. Clapp, Engineer H. Parker; Ongiara, Capt. R. McIntyre.

Matthews Line, Toronto, Ont.: Steamers—Niagara, Master, James Morgan; Engineer Thomas Mills. Clinton, Master, John Joyce; Engineer, Jno. Gray. Barges—Lisgar, Master, John Fahey. Grimsby, Master, S. Atkinson. Schooner—Clara Youell, Master, N. J. Colwill.

North Shore Nav. Co., Collingwood, Ont.: Steamers—City of Collingwood, Capt. W. J. Bassett, Engineer, Chas. Robertson; City of Midland, Capt. F. X. Lafrance, Engineer Wm. Whipps; City of Parry Sound, Capt. Ernest Walton, Engineer J. L. Smith; City of Toronto, Capt. A. C. Cameron, Engineer David McQuade; City of London, Capt. Geo. Dunn, Engineer C. Wilber.

The Toronto Ferry Co., Toronto, Ont.: Steamers—Primrose, Master, Chas. Tufford; Engineer Harry Brownley; Mayflower, Master, George Moulton; Engineer, Edward Abbey; Shamrock, Master, Thomas Jennings; Engineer D. Foley; Thistle, Master, Alex. Martin; Engineer, M. Murphy; Kathleen, Master, John Fertile; Soland Queen, Master, Joe Tymon; Engineer Thos. Good; Luella, Master, M. Corcoran; Engineer John Smiley.

Playfair Barge & Tug Line, Midland, Ont.: Steamer—St. Andrew, Capt. W. H. Featherstonehaugh, Engineer John McRae. Tugs—Magnolia, Capt. R. H. Gilberston, Engineer E. A. House; Metamora, Capt. Jas. Tyndall, Engineer George Smith; Minitaga, Capt. Ed. Burke, Engineer, Jno. Sinnott.

St. Lawrence & Chicago Steam Navigation Co., J. H. G. Hagarty, Mgr., Toronto, Ont.: Steamer—Algonquin, Capt. Jas. McMauger, Engineer, Jas. H. Ellis.

The Ottawa River Navigation Co.: Steamer—Sovereign, Capt. H. W. Shepherd, Commodore; Purser, D. M. Robertson; Pilot, Joseph Dufour; Mate, Joseph Bertrand; Steward, Alex. Sleeth; Engineer, Jos. F. Marchand. Steamer Empress—Capt., Alex. Bowie; Purser, W. A. Dorion; Pilot, John Galbraith; Mate, Alex. Arsen; Engineer, Geo. Menish. Steamer Duchess of York—Captain, John McGowan, jr.; Pilot, Pierre Sauve; Engineer, Alex. St. Laurent. Steamer Princess—Captain, Peter McGowan; Purser, John Kelley; Pilot, Hormidas Rabeau; Engineer, Ferd. Piche. Steamer Maude—Captain, E. Gauthier; Purser, A. S. McIntyre; Pilot, D. Dupuis; Engineer, Narcisse Fugere.

Calvin & Co., Garden Island, Ont.: Steamers—D. D. Calvin, Capt. A. Malone, Engineer T. C. Smith; Bothnia, Capt. Geo. Brian, Engineer R. Veech; Armenia, Capt. Chas. Coons, Engineer Geo. Hazlett; Chieftain, Capt. John Sullivan, Engineer Thos. Gray; Parthia, Capt. David Lefavre, Engineer Geo. Sauve; Johnston, Capt. D. Lefavre, jr., Engineer, Ed. Phelix; Bluebell, Capt. John Dix, Engineer Fred. Lefavre; Reginald, Capt. John Doyle, Engineer John Kennedy. Schooners—Ceylon, Capt. H. Smith; Augustus, Capt. Jos. Achee; Valencia, Capt. John Ferguson; Norway, Capt. John Harris.

The following are the officers of the Richelieu & Ontario Navigation Co.'s fleet, so far as appointed to date of publication: Algerian—Capt. A. Dunlop; 1st Engineer, Thos. Wadsworth. Berthier—Capt. C. Gouin; 1st Engineer, D. Laviolette. Bohemian—Capt. J. McGrath. Canada—Capt. Thomas Dugal; 1st Engineer, G. Lefebvre. Carolina—Capt. Reverin; 1st Engineer, L. Latulippe. Columbian—Capt. G. Batten. Corsican—Capt. Esford; 1st Engineer, Jno. Parker. Cultivateur—Capt. Raymond. Hamilton—Capt. Baker; 1st Engineer Geo. Marshall; Hochelaga—Capt. Mandeville; 1st Engineer A. Chapullon. Hosannah—Capt. Mongeau; 1st Engineer, H. Gendron. La Prairie—Capt. Peter McLean. Longueuil—Capt. Jodiona; 1st Engineer Boncage. Montreal—Captain not appointed; 1st Engineer F. X. Hamelin. Mouche-a-Fea—Captain not appointed; 1st Engineer P. Bouchet. Passport—Capt. McDonald; 1st Engineer W. Taylor. Quebec—Capt. L. O. Boucher; 1st Engineer J. B. Gendron. Spartan—Capt. H. P. Granger. Terrebonne—Capt. E. Gouin; 1st Engineer M. Sheridan. Three Rivers—Capt. F. St. Louis; 1st Engineer, F. Gendron.

Montreal Transportation Co., Kingston, Ont.: Steamers—Glengarry, Capt. Gordon Kean; Engineer, John Evans; Bannockburn, Capt. John Irving, Engineer R. Taylor; Rosemount, Capt, J. W. Mawdesley, Engineer H. Thurston; Active, Capt. Edward Bennett, Engineer, John Hamilton; Bronson, Capt. Jos. Murray, Engineer R. Hepburn; Glide, Capt. Thomas Murphy, Engineer, Geo. Tuttle; Jessie Hall, Capt. C. Martin, Engineer Alex. Barton; J. A. Walker, Capt. John Boyd, Engineer Geo. Boyd; D. G. Thomson, Capt. Jas. Murray, Engineer G. Henderson. Lake barges—Kildonan, Capt. Maxime Lefebvre; Minnedosa, Capt. R. C. Irwin; Selkirk, Capt. H. Colvin; Winnipeg, Capt. James Kirkwood; Melrose, Capt. James Fleming; Dunmore, Capt. John Phillips. River barges—Alberta, Capt. Frank Poirier; Acadia, Capt. Louis Hebert; Bella, Capt. Peter Lalonde; Cleveland, Capt. J. D. Parron; Chicago, Capt. Arsene Charlebois, sr.; Colborne, Capt. Ben. Sauvie; Corn Crib, Capt. A. Charlebois, jr.; Cornwall, Capt. H. Boyer; Detroit, Capt. Treffle Davust; Dorchester, Capt. Jules Lalonde; Eagle, Capt. A. Monnette, Jr.; Hector, Capt. Tim Hebert; Glengarry, Capt. Albert Major; Harvest, Capt. John Bradley, Jr.; Iowa, Capt. Jos. Davust; Jennie, Capt. Moise Moreau; John Gaskin, Capt. Theo. Leduc; Lancaster, Capt. Jos. Page; McCarthy, Capt. E. R. Roy; Montreal, Capt. M. Lefebvre; Maggie, Capt. A. Monnette; Nebraska, Capt. Celestia Leboeuf; Regina, Capt. Ovide Trudell; Senator, Capt. Alfred Lalonde; Star, Capt. E. Secotte; Toledo, Capt. Fred Leduc; Toronto, Capt. A. Levoie; Wheat Bin, Capt. A. St. Marcelles; Cobourg, Capt. Frank Lafrance; Brighton, Capt. N. Mallette; Kingston, Capt. Alex. Hebert.


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## MINERAL PRODUCTION OF CANADA.

The following summary of the mineral production of Canada in 1897 has been issued by the Geological Survey Department, and is subject to revision in a later bulletin :

| Product. | Quantity. (a) | Value. (a) |
|---|---|---|
| METALLIC. | | |
| Copper (fine, in ore, etc.) (b) ..... lbs. | 13,300,802 | 1,501,660 |
| Gold ..... | ..... | 6,190,000 |
| Iron ore ..... tons. | 71,451 | 178,716 |
| Lead (fine, in ore, etc.) (c) ..... lbs. | 39,018,219 | 1,396,853 |
| Mercury ..... " | 688 | 324 |
| Nickel (fine, in ore, etc.) (d) ..... " | 3,997,647 | 1,399,176 |
| Platinum ..... | ..... | 6,600 |
| Silver (fine, in ore, etc.) (e) ..... ozs. | 5,558,446 | 3,322 905 |
| Total metallic ..... | ..... | 13,996,234 |
| NON-METALLIC. | | |
| Asbestos and asbestic ..... tons. | 25,262 | 324,700 |
| Chromite ..... " | 2,637 | 32,474 |
| Coal ..... " | 3,876,201 | 7,286,257 |
| Coke (f) ..... " | 78,811 | 209,920 |
| Felspar ..... " | 1,275 | 3,506 |
| Fire clay ..... " | 1,923 | 5,759 |
| *Grindstones ..... " | ..... | 40,000 |
| Gypsum ..... " | 239,691 | 244,531 |
| *Limestone for flux ..... " | ..... | 40,000 |
| *Mica ..... | ..... | 75,000 |
| Mineral pigments— | | |
| Baryta ..... tons. | 571 | 3,060 |
| Ochres ..... " | 3,905 | 23,560 |
| *Mineral water ..... galls. | ..... | 140,000 |
| Molding sand ..... tons. | 5,485 | 10,931 |
| Natural gas (g) ..... | ..... | 325,873 |
| Petroleum (h) ..... bbls. | 709,857 | 1,011,546 |
| Phosphate (apatite) ..... tons. | 908 | 3,984 |
| Pyrites ..... " | 38.910 | 116,730 |
| *Salt ..... " | ..... | 190,000 |
| Sundry minerals, partly estimated, including actinolite, graphite, manganese, soapstone and tripolite ..... | ..... | 10,000 |
| STRUCTURAL MATERIALS AND CLAY PRODUCTS. | | |
| Cement, natural ..... bbls. | 85,450 | 65,893 |
| " Portland ..... " | 119,763 | 209,380 |
| Flagstones ..... | ..... | 7,190 |
| *Granite ..... | ..... | 75,000 |
| *Pottery ..... | ..... | 125,000 |
| Sewer pipe ..... | ..... | 164,250 |
| Slate ..... | ..... | 42,800 |
| Terra-cotta ..... | ..... | 155,595 |
| Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year) ..... | ..... | 3,600,000 |
| Total structural materials and clay products ..... | ..... | 4,445,108 |
| All other non-metallic ..... | ..... | 10,097,831 |
| Total non-metallic ..... | ..... | $14,542,939 |
| Total metallic ..... | ..... | 13,996,234 |
| Estimated value of mineral products not returned ..... | ..... | 250,000 |
| 1897, Total ..... | ..... | $28,789,173 |
| 1896 " ..... | ..... | 22,609,825 |
| 1895 " ..... | ..... | 20,715,319 |
| 1894 " ..... | ..... | 19,933,857 |
| 1893 " ..... | ..... | 20,035,082 |
| 1892 " ..... | ..... | 16 628,417 |
| 1891 " ..... | ..... | 18,976,616 |
| 1890 " ..... | ..... | 16,763,353 |
| 1889 " ..... | ..... | 14,013,913 |
| 1888 " ..... | ..... | 12 479,550 |
| 1887 " ..... | ..... | 11,365,705 |
| 1886 " ..... | ..... | 10,221,255 |

*Partly estimated.

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 11.29 cents per lb.

(c) Lead contents of ores, etc., at 3.58 cents per lb.

(d) Nickel contents of ore, matte, etc., at 35 cents per lb.

(e) Silver contents of ore at 59.79 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross return from sale of gas.

(h) Calculated from inspection returns at 100 galls. crude to 42 refined oil, and computed at $1.42½ per bbl. of 35 imp. galls. The barrel of refined oil is assumed to contain 42 imp. galls.

The following table shows the principal changes in production and values for the calendar year 1897, as compared with the figures given in the revised summary for 1896 :

| PRODUCT. | Quantity. Increase. p.c. | Quantity. Decrease. p.c. | Value. Increase. p.c. | Value. Decrease. p.c. |
|---|---|---|---|---|
| Metallic— | | | | |
| Copper | 41·6 | ..... | 46·9 | ..... |
| Gold | ..... | ..... | 122·6 | ..... |
| Iron ore | ..... | 22·3 | ..... | 6·7 |
| Lead | 61·2 | ..... | 93·7 | ..... |
| Nickel | 17·7 | ..... | 17·7 | ..... |
| Silver | 73·4 | ..... | 54·6 | ..... |
| Non-Metallic— | | | | |
| Asbestos and asbestic | 106·2 | ..... | ..... | 24·5 |
| Coal | 3·5 | ..... | 0·8 | ..... |
| Gypsum | 15·8 | ..... | 37·3 | ..... |
| Natural gas | ..... | ..... | 17·9 | ..... |
| Petroleum | ..... | 2·3 | ..... | 12·5 |
| Cement | 37·6 | ..... | 36·5 | ..... |

The increase in the items silver and lead is practically all to be credited to British Columbia, to which province is also largely due the increase in the production of copper. The largest increase in this latter metal is, however, due to the increased shipments of nickel-copper mattes from the Sudbury mines in Ontario. The third copper producing province, Quebec, also contributed a fair amount to the increase shown. The silver, copper and lead increases as far as British Columbia is concerned, represent the largely extended activities in the South Kootenay districts of Slocan, Nelson and Trail Creek.

The most significant item, however, is to be found in the increase of nearly 123 per cent. in the gold. All the gold producing districts of the Dominion show gratifying increases, although by far the largest part is due to the discoveries of rich placer mines in the Yukon country, and to the increased output of Trail Creek and other districts in British Columbia. The former increase amounted to about 2¼ millions and the latter to nearly $1,000,000.

The remaining metal of importance is nickel, which is seen to have shown an increase of nearly 18 per cent. As in the past this is all from the Sudbury district.

Thus the aggregate result of the increases in the metallic productions is nearly $6,000,000, or a proportion of about 74 per cent.

An interesting result of the mining developments and discovery of 1897 is shown in the increase in the proportion of the value of the total mineral production to be credited to the metals. In 1896 these constituted about 36 per cent., whilst in 1897 this proportion was increased to nearly 49 per cent.

Turning to the non-metallic products, we find that as far as the data at present available permit of a conclusion being arrived at, the total value shows under 2 per cent. of an increase over that of the previous year. The only considerable change to be noted is that given under the heading asbestos, where the quantity has more than doubled, whilst the value has fallen off almost 25 per cent. This is due to the fact that the output of the new by-product, asbestic, is included. This constitutes over half the weight of the whole, but being a low-priced article brings down the price per unit very much. The returns, however, show also a falling off in the prices of the usual grades of the mineral apart from the above influence.

In the important mineral coal the variation is but little. The falling off in the production of the higher priced mineral of British Columbia and the increase in that of Nova Scotia at a lower price causing a fall in the total value. In gypsum the increase in the value is larger than that shown in the quantity. This is due to the larger proportion of the higher priced product, plaster of Paris, included in the returns for 1897. The lower average price ruling during that year for petroleum caused the decrease in the value of this article to be much greater than in the quantity.

The following table gives the proportional values of the different minerals in the grand total. It is interesting to note the changes in their relative position in 1897, as compared with 1896 :

| Product. | 1896. Per cent, of Total Production. | Product. | 1897. Per cent. of Total Productio ·. |
|---|---|---|---|
| Coal | 31·94 | Coal | 25·31 |
| Building material | 15·72 | Gold | 21·50 |
| Gold | 12·30 | Building material | 12·50 |
| Silver | 9·50 | Silver | 11·54 |
| Nickel | 5·25 | Copper | 5·21 |
| Petroleum | 5 11 | Nickel | 4·86 |
| Copper | 4·52 | Lead | 4·85 |
| Lead | 3·20 | Petroleum | 3·51 |
| Asbestos | 1·90 | Natural Gas | 1·13 |
| Natural Gas | 1·22 | Asbestos | 1·13 |
| Cement | ·89 | Cement | ·95 |
| Iron | ·85 | Gypsum | ·84 |
| Gypsum | ·79 | Coke | ·73 |
| Salt | ·75 | Salt | ·66 |

## ONE-TIME INSERTIONS.

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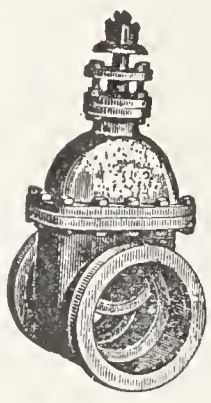

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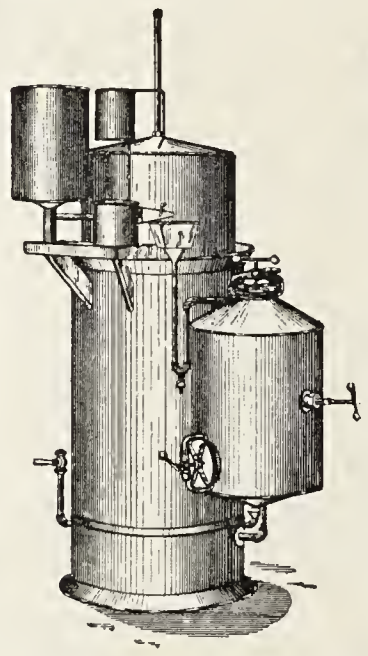

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